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Running head: WORKSTYLE INTERVENTION

Workstyle Intervention for the Prevention of Work-Related Upper Extremity Problems: A Randomized Controlled Trial

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ABSTRACT

Workstyle is a description of how people perform their work and is proposed as a mechanism by which ergonomic and psychosocial stressors in the workplace interact with the individual's cognitive and behavioral responses to work demands, which place a worker at risk for the development and/or exacerbation of work-related upper extremity symptoms and disorders (WRUES/Ds). Recent investigations have shown that multicomponent interventions (i.e., ergonomic redesign and individual stress management) show promise for increasing the effectiveness and durability of intervention benefits. Therefore, inclusion of workstyle-related interventions into workplace WRUED prevention (primary and secondary) programs may result in better overall treatment gains because a focus on workstyle may simultaneously address multiple risk factors for WRUEDs. This study compared treatment outcomes for interventions combining workstyle and ergonomic modification at the workplace compared to addressing workstyle or ergonomic management alone. Symptomatic workers were recruited to participate in one of the three intervention conditions or in a wait-list control condition, where measures of ergonomic risk, psychosocial stress, workstyle response, and symptom status were collected at baseline, post-treatment, and at a 3-month follow-up period. Results indicated that although all groups improved over time, no intervention produced outcomes superior to the control group. The results suggest that future interventions should be more intensive to produce significant and lasting improvements.

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INTRODUCTION

Work-related musculoskeletal disorders have received significant attention in recent years because of their growing impact on modern workers. Although work-related musculoskeletal pain was identified as early as 1713 by Ramazzini, these painful health problems have become an increasingly significant source of difficulty and cost for the modern worker. Work-related upper extremity disorders (WRUEDs), in particular, have been of increasing concern due to long and costly recuperation and/or treatment times that are required to address workers' discomfort (Bureau of Labor Statistics [BLS], 2003; Feuerstein, Miller, Burrell, & Berger, 1998). Interventions for these disorders are hampered at this time by the absence of clear etiologies for the symptom constellations, variability in the diagnoses, mixed evidence for treatment modalities, individual differences in the presentation and course of symptoms, and the duration of symptoms prior to seeking medical attention (National Research Council [NRC], 2001; Downs, 1997; Linton, 2002). However, despite these limitations in the available information about WRUEDs, a significant amount of multidisciplinary research has yielded important information about the course of these disorders and the potential components that require modification for the treatment and/or prevention of negative health outcomes.

Definitions, Prevalence, and Costs

According to the U.S. Department of Labor, musculoskeletal disorders are injuries or disorders of the muscles, nerves, tendons, joints, cartilage, and spinal disks that are not caused by slips, trips, falls, motor vehicle accidents or similar accidents (BLS, 2003). Work-related upper extremity disorders are defined as musculoskeletal disorders of the upper extremity (including the neck, shoulder, arm, elbow, wrist, hand, and fingers) that are caused, exacerbated, and/or maintained by the work tasks and/or environment and can be associated with significant pain and

loss of upper extremity-related function (NRC, 2001). A number of diagnoses associated with disorders of a specified location on the upper extremity are included in the term WRUED (i.e., carpal tunnel syndrome, tendonitis, deQuervain's tensynovitis, lateral epicondylitis, etc); however, most individuals typically complain of symptoms in the entire upper extremity (Mackinnon & Novak, 1994) and the specified diagnoses are often only a part of the overall clinical picture of discomfort and loss of function in many upper extremity anatomical locations (Pascarelli & Hsu, 2001; Novak & Mackinnon, 2002).

Work-related upper extremity symptoms can vary between individuals, but most are described under the term nonspecific upper extremity pain syndrome (Pascarelli & Hsu, 2001). This category of symptoms includes pain throughout the upper extremity, paresthesias or numbness in the hand and/or forearm, cramping and stiffness in the musculature of the upper limb, neck, and shoulders, and limitation in movement and/or function at any of these anatomic locations (Mackinnon & Novak, 1994). Symptoms associated with this condition often become worse and more persistent if there is continued exposure to the adverse conditions that contribute to the onset of the symptoms. Early symptoms can include aching pain, muscle tightness and fasciculations, stiffness, weakness, and tingling or numbness in the hand or fingers (Pascarelli & Hsu, 2001). During the early stages of the development of symptoms and disorders, the individual experiences discomfort that remits when the work task is halted or during rest breaks. Symptoms may increase in intensity, frequency, or duration, but remain intermittent and resolve with rest, such as over weekends (Terrono & Millender, 1996). Over time, symptoms can become more severe and increasingly interfere with work and nonwork-related functioning until criteria are met for specific disorders, usually of the distal upper extremity (i.e., carpal tunnel syndrome); although symptoms persist in the entire upper extremity, including the upper arm,

shoulder, and neck. Pascarelli & Hsu (2002) argue that proximal upper extremity symptoms are often overlooked because most initial signs occur in the distal upper extremity, but a complete analysis will reveal symptoms in the proximal upper extremity, regardless of the stage of progression. Therefore, these authors suggest that regardless of a given diagnosis, attention should be paid to symptoms in the entire upper extremity (Pascarelli & Hsu, 2002).

Much of the interest in WRUEDs was generated by findings relating to the significant economic, personal, and societal burdens associated with these disorders. Although these disorders are not life-threatening, they are life-altering in that individuals with WRUEDs often must manage pain and other symptoms and lose the ability to conduct previously enjoyed activities. Evidence regarding the prevalence of WRUEDs is unclear and the prevalence of symptoms (not yet meeting criteria for disorders) is even less understood. Atroshi and colleagues (1999) estimated the prevalence of carpal tunnel syndrome in a general population using a stratified sample of 2466 subjects from Sweden. These authors found that 14.4% of the sample reported symptoms in the hands, and of these, 94 were diagnosed with carpal tunnel syndrome (3.8% prevalence; Atroshi, Gummesson, Johnsson, et al., 1999). Tanaka and colleagues (2001) examined the prevalence of tendonitis and related disorders in U.S. workers using data from the 1988 National Health Interview Survey. Of 30,074 respondents, 588,000 (approximately 0.5%) reported that they had received an upper extremity disorder diagnosis by a medical person. Of these, 164,000 cases were thought to be work-related by the medical professional conducting the diagnoses. The authors concluded that these disorders, combined with prevalence information about carpal tunnel syndrome, indicated that nearly 520,000 cases of WRUEDs of the distal upper extremity were diagnosed in 1988 (Tanaka, Petersen, & Cameron, 2001). Silverstein and colleagues (1998) examined the incidence rates of WRUEDs in Washington State from 1987 to

1995. The authors found an incidence rate of 98.2 (out of 10,000) for hand/wrist disorders, 29.7 for elbow disorders, and 54.0 for shoulder disorders (Silverstein, Welp, Nelson, & Kalat, 1998). In an examination of the federal workforce, Feuerstein and colleagues (1998) found that in a 1-year period, 5,844 claims (from a total 185,927 claims; 3%) accepted by the U.S. Department of Labor listed a single upper extremity disorder as the sole claim filed by an employee.

Although the prevalence of WRUEDs may seem relatively small (1-5% of all claims), the costs associated with these disorders are significant. Feuerstein and colleagues (1998) found that total health care costs related to upper extremity disorders in the federal workforce amounted to $12,228,755, with carpal tunnel syndrome and enthesopathy of the elbow contributing to the bulk of expenses. The average lost workdays for these problems ranged up to 84 days depending on the disorder, medical costs averaged approximately $3,000 per case, and average indemnity costs ranged up to nearly $5,000 per case (Feuerstein et al., 1998). Similarly, Silverstein and colleagues (1998) reported that average direct worker's compensation costs for WRUEDs in Washington State ranged up to $15,790 per case between 1987 and 1995 with 66 to 97 median workdays lost, depending on the disorder. Additionally, the Bureau of Labor Statistic's (2003) report of injuries and illnesses lists musculoskeletal disorders as a significant source (one-third) of all lost workday cases, with the highest median days away from work attributed to carpal tunnel syndrome (25 days) over fractures (21 days) and amputations (18 days) for all major disabling injuries and illnesses. Overall, the costs associated with WRUEDs are substantial, with a total estimated burden of up to $2.19 billion annually in direct (i.e., healthcare, workers compensation, etc.) and indirect (i.e., lost productivity, lost tax revenues, etc.) costs (National Occupational Research Agenda, 1999).

Pathophysiology & Pathogenesis

The recurrent nature of these disorders may be a contributor to the significant costs associated with WRUEDs. Additionally, treatments are limited by the lack of a clear etiology for these disorders and/or pain syndromes. However, studies of the pathogenesis and pathophysiology of WRUEDs reveal physiological changes to the tissue structure and function of the upper extremity, which can be difficult and costly to treat and/or can contribute to the long-term disability associated with these disorders (Barr & Barbe, 2002). These tissue changes can begin early in the exposure to force loadings, awkward postures, and repetitive motion. Remple and colleagues (1999) studied the effects of nerve compression and showed that within hours, compression to the nerves results in reduced blood flow and alteration or damage to the structure of the myelin sheath. The authors note that persistent intraneural edema was observed in animal models even after short-term compression. Long term effects of a 2-hour period of compression in animal models included increased inflammation, decreased circulation, edema, and scarring of the nerve. Axonal degeneration and demyelination also occurred. These effects contribute to the loss of function and presentation of work-related upper extremity symptoms, such as pain and numbness (Remple, Dahlin, & Lundborg, 1999).

Physiological changes are also likely to occur in tendons and muscles of the upper extremity during forceful, repetitive work. Tendons transmit tension, compression and shear forces from the muscle to the skeletal system to enable movement; however, injuries to the tendons can occur when these forces exceed tolerable limits and/or if the tendons experience compression loads in addition to tension (NRC, 2001). Animal models have shown that under these conditions, tendons experience microtears, inflammation, and edema (Barr & Barbe, 2002).

Muscles are susceptible to injury under working conditions where the forces exceed the optimal loading for the muscle or when the muscle fibers are stretched beyond their optimal length (Mackinnon & Novak, 1994). Additionally, some working conditions require that muscles be maintained and used in shortened positions. These muscles may become painful if stretched. Other work conditions require underuse and subsequent weakening of muscles. Weakened muscles require compensatory overuse in another set of muscles, establishing a self-maintaining cycle of muscle imbalance where tight muscles become tighter and weakened muscles become weaker, reducing the ability to relieve the associated symptoms related to this imbalance (Mackinnon & Novak, 1994). Animal models and human tissue studies have demonstrated changes in muscular structure, including muscle fiber imbalances associated with repeated injury and cellular pathology consistent with localized hypoxia in both humans and animals exposed to repetitive motion (Barr & Barbe, 2002).

There is also some evidence that WRUEDs may involve a central nervous system component in the development and maintenance of symptoms. Melzack (1999) has proposed a neuromatrix theory of pain that suggests that the relationship between the perceptual and stress systems that is implicated in various pain therapies is because these two systems are interdependent components of a single system. This system is comprised of a neural network including somatosensory, limbic, and thalamocortical components. According to this theory, central nervous system responses can affect how an individual perceives pain from the neural perceptual mechanisms. Melzack (1999) cites evidence such as the effectiveness of antidepressant medications for assisting in pain relief, the use of hypothalamic and pituitary lesions for the treatment of chronic and cancer pains, and cognitive processes (i.e., stress) that affect the sensation of pain through neuroendocrine processes. This theory provides a

framework for understanding how psychological process can contribute to chronic pain. In addition to the destructive effect of some stress-related endocrine responses (e.g., the inhibitory effect of cortisol on the immune system), adaptation to chronic or recurrent stressors can make the stress-response system more sensitive to the pain sensation (e.g., physical and cognitive appraisal) of later minor injuries. Therefore, psychological stressors can result in chronic pain either by directly affecting tissues via endocrine responses, by increasing the severity of pain sensations from minor injuries in a chronically stressed system, or through the combined effects of both direct tissue changes and increased sensitization of the response system (Melzack, 1999). This theory is supported by recent evidence from animal models that showed neuroplastic changes may occur at multiple levels in the somatosensory pathways, such as the dorsal horn, as a result of the inflammatory processes from peripheral nerve injuries following repetitive forceful motion (Barr & Barbe, 2002).

Risk Factors

The pathophysiological changes described above are the proposed biological mechanisms for the development of upper extremity symptoms and eventually, disorders. However the exact mechanisms that initiate or contribute to these physiological processes remain unclear at this time. However, it is clear that factors that expose the musculoskeletal system of the upper extremity to conditions including force loading, repetition, and compression may contribute to the development of WRUE symptoms and disorders. Although the etiology of these injuries is not yet defined, research has identified several risk factors, which can be organized into the categories of physical, psychosocial, and individual factors.

Physical Risk Factors

The physical risk factors category is the most obvious category and includes the physical aspects of the task including the biomechanical postures and/or movements that are induced by the ergonomic design and/or task characteristics. Some of the physical risk factors that have been identified include static work postures, non-neutral upper extremity positions, repetitive motion, forceful work, exposure to vibration, and inadequate rest breaks (NRC, 2001; Armstrong et al., 1993; Bergqvist, Wolgast, Nilsson, & Voss, 1995; Buckle, 1997; Warren, Dillon, Morse, Hall, & Warren, 2000). These physical characteristics of the task may lead directly to the conditions of compression, tension, and excess force that were identified above as contributors to the pathogenesis of WRUEDs (Remple et al., 1999; Barr & Barbe, 2002).

Psychosocial Risk Factors

The psychosocial risk factors category includes stressors related to the workplace or work tasks that are both individual and organizational in nature. This category of risk factors is less obvious than the physical risk factors category because the mechanism that connects mental processes involved in stress and the force and compression loads on the musculoskeletal tissues is not immediately visible. The neuromatrix theory of pain proposed by Melzack (1999) provides an overall framework for understanding recurrent/persistent pain as a systemic response of physiology and anatomy. However, much of the current literature on stress responses and upper extremity disorders proposes a link between stress and muscle tension and focuses only on these components. Melin and Lundberg (1997) reviewed a number of studies, which demonstrated that mental activity (i.e., thinking about a muscle) can result in increased tension in the muscle under attention. More recently, Storey (2002) demonstrated that the recall of stressful events resulted in increased forearm muscle activity in individuals with a variety of upper

extremity symptoms/disorders (with a large representation of carpal tunnel syndrome cases). In addition to stress-induced muscle tension, there are indications that other physiological mechanisms may contribute to the onset and course of WRUEDs. Lundberg (2002) reviewed endocrine responses to work stress with particular emphasis on the sympathetic adrenal medullary (SAM) system and the hypothalamic pituitary adrenocortical (HPA) system. This review highlighted several studies showing that manual workers, such as cashiers (occupation with frequent WRUED complaints [e.g., Lundberg et al., 1999]), have a greater increase in levels of epinephrine and norepinephrine during work than do white collar workers and are more likely to have elevated cortisol levels under prolonged periods of stress. According to this review, the stress-related physiological responses place these workers at increased risk for WRUEDs. Several models have implicated these stress-related endocrine responses as mechanisms by which muscle tension is initiated and maintained, nociceptors are stimulated, and fatigue of musculoskeletal tissues occurs, all of which lead to injury and symptoms characteristic of WRUEDs. It is also possible that the anti-inflammatory effects of cortisol may delay healing of musculoskeletal injury in workers exposed to chronic stress (Kiecolt-Glaser, Page, Marucha, MacCallum, & Glaser, 1998). The studies in the Lundberg (2002) review, as well as others relating to muscle tension demonstrate that stress has some role in the pathophysiological processes associated with WRUEDs. Nevertheless, the exact mechanisms that connect psychosocial stressors to the course of WRUEDs remain unclear.

Despite this unclear pathophysiological process between stress and pain/symptoms, there is growing epidemiological evidence that psychosocial stress is a risk factor for WRUE symptoms and disorders. Several aspects of psychosocial stress, including high perceived workload, high perceived job stress, low decision latitude, and time pressure, have all been

identified as psychosocial risk factors (Fredriksson et al., 1999; Bongers, Kremer, & ter Laak, 2002; Warren et al., 2000; Buckle, 1997). Organizational factors that have been identified include lack of social support, limited opportunity for breaks, and high overtime demands (Fredriksson et al., 1999; Bongers et al., 2002; Buckle, 1997; Warren et al., 2000). However, according to an evidence-based review of the literature on psychosocial risk factors for WRUEDs, high job demands, high job stress, and nonwork-related psychological distress were most consistently associated with the occurrence of upper extremity symptoms and disorders (NRC, 2001). This evidence is limited by the cross-sectional nature of the studies under consideration and the few prospective studies in this area. A prospective study of WRUED risk factors in computer users after 3 years did not prospectively examine psychosocial variables from their entire sample and did not examine these variables if they did not have an impact on the hazard ratios for postural variables in the model (Marcus et al., 2002). However, the results of a 24-year follow-up study support the findings of the National Research Council (NRC, 2001) review by demonstrating that high physical demands at work, with the addition of high mental workloads, additional domestic workloads, and dissatisfaction with leisure time were all associated with upper extremity disorders (Fredriksson et al., 1999). These epidemiological data provide growing support that a complex, systemic evaluation of pain response including physical, physiological, and psychological factors, such as Melzack's neuromatrix theory (1999) may be required to truly understand WRUEDs.

Individual Risk Factors

The individual risk factors category includes personal, demographic, and biomedical risk factors that may be inherent to the individual and may or may not be subject to modification. The risk factors that are classified under this category in the current paper are more

heterogeneous than the prior two categories and many may not be directly related to the workplace. However, all have been identified in the epidemiological research as risk factors for WRUEDs and exert some influence on the individual to contribute to the course of WRUEDs, even though the mechanisms may not be entirely clear. Demographic risk factors include gender (female) and increased age (Bergqvist et al., 1995; Fredriksson et al., 1997; Gerr et al., 2002). Biomedical risk factors have been identified to include previous injury or symptoms in the upper extremity, inflammatory arthritis, thyroid disease, diabetes mellitus, pregnancy, and obesity (Gerr et al., 2002; Bergqvist et al., 1995; Solomon, Katz, Bohn, Mogun, & Avorn, 1999; Atcheson, Ward, & Lowe, 1998; Stevens, Beard, O'Fallon, & Kurland, 1992).

Upper Extremity Disorder Models

Balance Theory

Several authors have proposed models to explain the potential interaction among physical, psychosocial, and individual risk factors for the development of WRUEDs (Huang, Feuerstein, and Sauter, 2002). For example, Carayon, Smith, and Haims (1999) proposed a Balance Theory of job design and stress model specific to WRUEDs that is based upon a "feedback loop" of short and long term stress responses on the workplace and the individual's characteristics. The work system results in short-term stress responses, which lead to long-term stress outcomes. According to Carayon and colleagues, the work organization consists of workplace ergonomic and psychosocial stressors. Individual characteristics, such as stress appraisal, personality, and skills are proposed to affect each of the model components. The long-term outcomes continue the model's cycle by influencing the individual's perception of the work organization (Carayon et al., 1999). While this model is useful for describing how WRUEDs may develop in general, there was no elaboration on *how* the individual characteristics affect the

work organization and stress response components. Furthermore, the model does not describe the processes that trigger individual responses and how these impact the work system to contribute to the formation and course of WRUEDs. Nevertheless, the model does acknowledge that these differences do occur, and suggests that exploration into these individual characteristics is warranted (See Figure 1).

Insert *Figure 1* about here

Biopsychosocial Model

Melin and Lundberg (1997) proposed a Biopsychosocial Model of job stress and musculoskeletal disorders in individuals who perform work that consists of low physical demands such as computer-related occupations. According to the model, mental and physical workplace stressors may produce physiological responses that can contribute to the experience of upper extremity symptoms. These workplace stressors may occur due to overstimulation or understimulation while at work. This model also addresses the contribution of nonwork-related stressors and responses by proposing that the nonwork-related influences prevent full recovery from stress and physiological arousal, sustaining muscle tension and psychological distress. The chronic physiological excitation over time increases the individual's risk for developing WRUEDs by exposing the upper extremity tissues to continued or episodic physical strain. The biopsychosocial model's consideration of the non-work-related factors and recognition of the stress related to understimulation at work are two of the strengths of this model. However, this model does not address the specific workplace or individual components that may lead to potentially high-risk physiological responses. This model is complementary to other models designed to highlight the specific effects of workplace and individual variables on WRUEDs (see Figure 2).

Insert *Figure 2* about here

Ecological Model

A third proposed model of WRUEDs is the Ecological Model of musculoskeletal disorders by Sauter and Swanson (1996). According to this model, biomechanical strains imposed by the workplace and task are compounded by the individual's physiological responses to psychological strain resulting from workplace psychosocial stressors. This model recognizes individual differences in perception, attribution, and other cognitive processes by indicating that these characteristics moderate the experience of symptoms. For example, the individual's characteristics, such as stress appraisal and attribution style, can determine how and when symptoms are detected and the explanation for these symptoms. If the worker attributes their pain and discomfort as originating in the workplace, his or her subsequent illness behaviors, such as help seeking or injury reporting, can be influenced by how s/he views the organizational climate. Additionally, the upper extremity symptoms themselves as well as attributions regarding the workplace as the cause of the pain may increase the perception of stress while working (Sauter & Swanson, 1996). The ecological model is one of the more comprehensive models of the WRUED formation process. One of the strengths of this model is its consideration of the cognitive components that can differentially affect the etiology, exacerbation, and maintenance of WRUEDs. This model also addresses the ergonomic and job stress components that can contribute to WRUEDs. Nevertheless, clarification and explanation of the cognitive and biomechanical components of the individual's response to workplace stressors is required for a more complete understanding of the processes involved in the development of WRUED (see Figure 3).

Insert *Figure 3* about here

The Workstyle Model

Each upper extremity disorder model described earlier makes a contribution to the theoretical understanding of WRUEDs. However, as noted in each description, the individual characteristic components and their influences are not thoroughly defined. There is a need to focus on the individual's interaction with the work environment because investigations into the etiology of WRUEDs indicate that the individual's characteristic responses to work demands are associated with upper extremity symptoms (Feuerstein & Fitzgerald, 1992; Lundberg et al., 1999; Feuerstein, Huang, Haufler, & Miller, 2000a; National Research Council, 2001). Therefore, models that address such factors may contribute to a more comprehensive understanding of the workplace's role in the course of WRUEDs. One such model that addresses this limitation, proposed by Feuerstein in 1996 and refined by Feuerstein and colleagues in 1999, is the workstyle model (see Figure 4).

Insert *Figure 4* about here

The workstyle model is based upon the hypothesis that *how* an individual performs his/her work tasks in reaction to increased work demands may lead to the etiology, exacerbation, and/or maintenance of WRUEDs (Feuerstein, 1996). Individuals experience different levels of psychological and physiological arousal while at work. This arousal may interact with the physical task, workplace environment, psychosocial stressors, and the individual's characteristics (i.e., perceptual style, training, coping methods, etc.) to influence the cognitions and/or biomechanical behaviors the individual generates and the occurrence of behaviors that contribute to recovery, such as rest and stretching breaks while at work. The cognitive and behavioral components of an individual's workstyle may become particularly detrimental to musculoskeletal health when the individual is under high work demands and/or psychological

distress. In such a case, the person may respond to increased job demands by generating negative cognitions including fears of making mistakes, perfectionistic thoughts, etc., which may be associated with and/or drive risky behaviors such as repeated, forceful, and rapid motions for a sustained period of time. These responses are hypothesized to be a mechanism for interaction of the physical, psychosocial, and individual risk factors for the development of WRUEDs (Armstrong et al., 1993; Fredriksson et al., 1999, National Research Council, 2001; Bergqvist et al., 1995; Gerr et al., 2002). Therefore, workstyle can be defined as the cognitive, behavioral, and physiological responses an individual makes in response to work demands. To clarify, individuals who are placed under demands at work may generate responses that are psychological (i.e., stress appraisal and angry or depressive cognitions), physiological (i.e., autonomic responses such as cold hands or shallow breathing), and behavioral (i.e., forceful repetitive motion without rest). These collective responses are conceptualized as the individual's workstyle.

It is important to note that workstyle is not conceptualized as a personality trait, but instead as a learned and/or reinforced strategy to completing, responding to, or coping with increased job demands that places the individual at risk for WRUEDs. Workstyle is hypothesized to be a normally distributed pattern of responding among individuals such that nearly all people may exhibit maladaptive workstyles under certain, individually-determined conditions. However, people may exist at the extremes of this normal distribution such that some individuals may be more susceptible (i.e., have a lower threshold) to responding in an adverse way to increased job demands. The model proposes that potentially high-risk behaviors (i.e., working forcefully without rest) may be driven by perceived stress and negative cognitions (i.e., related to fear, anger, or uncertainty), or are self-generated by a need for achievement or

approval or out of fear of adverse consequences. Whether environmentally or internally triggered, the repeated elicitation of these behaviors can lead to a cascade of physiological changes that over time can set the stage for increased levels of fatigue, pain, and functional limitations that are frequently observed in individuals with various work-related upper extremity symptoms/disorders (National Research Council, 2001; Feuerstein, 1996).

A maladaptive workstyle may consist of cognitive, behavioral, and/or physiological components, such as feelings of distress, sustained forceful movements or awkward postures, and heightened levels of muscle tension, respectively. The elicitation of this high-risk workstyle can lead to acute symptoms of pain, tension, and stiffness. If repeatedly activated, these short-term symptoms and concomitant physiological processes (such as muscle tension and endocrine responses as discussed previously) could, over time, lead to chronic upper extremity symptoms, disorders, and even disability. The model also proposes a "feedback" mechanism where the symptoms and disorders exacerbate the demands, psychosocial stressors, and ergonomic risks inherent in the workplace, increasing the likelihood of an adverse workstyle (Feuerstein, 1996; Feuerstein, Huang, & Pransky, 1999). Although the exact biobehavioral processes are unclear at present, research has corroborated this theoretical process leading to WRUEDs.

Supporting Research for the Workstyle Model

Some recent studies provide indirect support for the workstyle concept given their findings on individual differences in biomechanical and physiological responses to work demands during ergonomic assessments and interventions in asymptomatic participants. These studies were not designed to specifically measure workstyle, but the outcomes of these studies suggest that certain factors consistent with the workstyle construct appear to be associated with increases in biochemical strain and, thus, can set the stage for the onset or exacerbation of upper

extremity symptoms. One such study was conducted by Marcus and colleagues (2002) who prospectively examined the relationship between upper extremity posture at baseline and the development of work-related upper extremity symptoms over 3 years. These authors found that individuals who worked with postures that were more deviated from neutral were at increased risk for the development of upper extremity disorders. Additionally, the authors found that individuals who used greater force to activate keyboard keys were associated with an increased risk of hand and arm disorders (Marcus et al., 2002).

Armstrong and colleagues (1994) conducted a study to examine the finger forces required to activate the keys of different computer keyboards. Key displacement and key forces were measured for three types of keyboards used by experienced, asymptomatic keyboard users. The results of this study indicated that the users produced forces greater than necessary to activate the keys across all the keyboards, and that the forces generated differed according to the type of keyboard being used. Another finding of particular significance was the wide variability in the forces generated across participants who were keying to the identical task. The average key forces ranged from 1.3 Newtons to 2.9 N, whereas the amount of force required to activate the keys was less than 1 N (Armstrong, Foulke, Martin, Gerson, & Remple, 1994). The workstyle construct is a possible explanation for this inter-subject variability in force generated in response to a fixed work task because it recognizes the individual differences behavioral response that may correspond to the task demands.

A study with similar findings was conducted by Parlitz and colleagues (1998) to investigate the dynamic finger forces in novice and expert piano players. The aim of this study was to measure the use of finger force in piano playing, which, if inefficient, may contribute to upper extremity symptoms/disorders in musicians (Fry, 1989). In this experiment, participants

were required to perform three finger exercises of increasing difficulty on the piano keyboard. Measurements relating to the amount of force applied to the keys and the duration of forceful contact with the keys were collected. The authors found that novice players generated more force overall and sustained this force on the keys for longer duration than did the expert players. Additionally, as task difficulty increased, both the expert and novice players exerted more force on the keys for longer period of time (Parlitz, Peschel, & Altenmuller, 1998). The results support the workstyle concept by suggesting that increased work demands, both actual and perceived (as may be the case for the novice players), are associated with behaviors that produce sustained force in excess of that required while working. This increase in behavioral arousal is characteristic of an adverse workstyle (Feuerstein, 1996).

Another study providing indirect support for the workstyle concept is one conducted by Burgess-Limerick and colleagues (1999) which compared suspected ergonomic risk postures associated with computer mouse and trackball use. The study was designed to determine if using a trackball rather than a mouse resulted in fewer deviations from a neutral wrist posture. Participants in this study were required to perform tracking tasks (e.g., tracking a moving display with the cursor) using each of the pointing devices. Participants were encouraged to perform their tasks both as accurately and quickly as possible and measurements of wrist extension and ulnar deviation were collected. Although the results of the study indicated that the trackball significantly decreased the frequency of wrist postures involving ulnar deviation, the authors were unable to definitively conclude that the trackball was an improvement over the mouse as a pointing device because the trackball significantly increased wrist extension. Interestingly, another reason for this inability to state a definitive conclusion was the amount of individual variability in postures across participants associated with both devices. For some participants,

the non-neutral wrist postures were not reduced by the trackball. In these cases, deviated wrist postures occurred regardless of the pointing device used. For other participants, the trackball decreased the amount of ulnar deviation in their wrist postures, but increased the exposure to extreme wrist extension (greater than 30 degrees) beyond the average level experienced by the participants. Because of the variability in the results, the authors stated that individual differences must be considered before initiating an ergonomic intervention (Burgess-Limerick, Shemmell, Scadden, & Plooy, 1999).

The study by Burgess-Limerick and colleagues (1999) provides indirect support for the workstyle concept by indicating that individuals adopt differing postures in response to work demands. It is also similar to the study by Marcus and colleagues (2002) since both identify the presence of a subset of individuals who have a characteristic propensity to engage in high-risk postures, regardless of ergonomic changes to the workstation. Additionally, since the task in this study emphasized speed and accuracy the work demands and possibly stress factors were increased, which may have increased the likelihood of high-risk postures, regardless of the workstation layout and ergonomic devices used.

This response to work demands in terms of posture and behavior is hypothesized to be a feature of an individual’s workstyle according to the workstyle concept (Feuerstein, 1996). Support for characteristic behavioral responses stems from a study of soft-tissue injuries related to computer keyboard use in severely injured computer users (Pascarelli & Kella, 1993). The investigators identified different characteristic postures and “keyboard techniques” that were assumed by the participants during work conditions using a computer keyboard. Of particular note were those workers who expended great amounts of energy when pressing keys, resulting in a loud, clacking noise. These “clackers” worked rapidly and with an intensity of demeanor, and

although direct comparisons were not made, the authors suggest that these workers may have a higher incidence of epicondylitis when compared to workers with other techniques (Pascarelli & Kella, 1993). The studies conducted by Burgess-Limerick and colleagues (1999) and Pascarelli and Kella (1993) support the hypothesis that individuals may have characteristic approaches to work in terms of posture and behavior that place them at increased risk for WRUEDs.

Mathiassen and Aminoff (1997) conducted another interesting laboratory study supporting the workstyle concept's identification of differential behavioral and physiological responses by individuals in response to task demands. In this study, ten females were required to maintain an isometric shoulder flexion by holding their arms straight and in a horizontal position for 15 minutes or until fatigued while surface electromyogram (EMG) readings were recorded. The authors of this study found that while most of the participants demonstrated muscle activity that was consistent with the physiological model of motor control for this task, there were individuals whose EMG readings differed from the expected results. The authors postulated that this difference among individuals may have been related to differing motor unit recruitment strategies and susceptibility to fatigue, differences in behaviors during the task (some individuals frequently adjusted their arm posture within the limits of the task), or differences in sensory feedback from muscle spindles. The authors concluded that individuals may differ considerably in their motor control strategies during prolonged work activity. The authors also suggested that while the static task in the study differed from dynamic work motions, the results of this study may be useful for understanding why occupational tasks may result in musculoskeletal disorders in some individuals but not in others exposed to the same tasks (Mathiassen & Aminoff, 1997).

Controlled studies with participants who have WRUE symptoms have also provided evidence that supports the workstyle model. One study examined the biomechanical factors

relating to upper extremity disorders in professional sign language interpreters (Feuerstein & Fitzgerald, 1992). This group of workers had come to the researchers' attention due to the high rate of upper extremity disorders (as high as 60% in 1990) diagnosed in this group (DeCaro, Feuerstein, & Hurwitz, 1992). The researchers evaluated the psychosocial and ergonomic risk factors that the workers encountered in a standard work task. The ergonomic stressors in this case were of particular note because there were no physical interfaces; rather, the workers' ergonomic risks involved bodily motions and postures assumed during the course of their work. Symptomatic and asymptomatic participants' upper extremity motions were observed for hand/wrist deviations from a neutral position, reaching beyond an ideal workspace envelope, pace of finger/hand motions, high-impact hand contacts, and smoothness of finger/hand movements, as well as time spent at rest breaks. Self-reported ratings of pain, fatigue, and function were also collected (Feuerstein & Fitzgerald, 1992).

The results of this study indicate that the symptomatic group of sign-language interpreters engaged in potentially high-risk behaviors from a biomechanical perspective and reported more adverse outcomes than the asymptomatic group in response to the same work demands. Those participants who reported working with pain were more likely to engage in rapid, forceful, "jerky" movements outside an anthropometrically ideal workspace, as compared to those working without pain whose movements were more flowing, smooth, and less likely to extend beyond an optimal work envelope. Additionally, sign language interpreters with pain spent less time at rest than did those interpreters working without pain (Feuerstein & Fitzgerald, 1992). As is the case with the "clackers" in the Pascarelli & Kella (1993) study, these findings support the workstyle concept by indicating that individuals who engage in potentially high-risk behavior, beyond that required by the actual task, during work are more likely to experience upper

extremity symptoms. However, these conclusions must be viewed with caution because of the cross-sectional nature of the studies.

Another study that supports the role of workstyle in office-related upper extremity disorders was conducted by Feuerstein and colleagues (1997a) on the differences in keyboard force produced by participants with high levels of upper extremity symptoms compared to those with lower levels of upper extremity symptoms. In this study, participants were required to perform a standard typing task while force applied to the keyboard was measured. Although both groups produced more force than required to activate the keys, as was seen in the similar study by Armstrong and colleagues (1994), the participants with higher reported levels of symptoms produced significantly more keyboard force than did the participants with lower levels of symptoms. Those with higher levels of symptoms also reported significantly more discomfort throughout the task (Feuerstein, Armstrong, Hickey, & Lincoln, 1997a). This study suggests that individuals who generate potentially high-risk work behavior with a biomechanical consequence (i.e., increased force on digits) are more likely to experience upper extremity symptoms. Unfortunately, conclusive statements regarding the causality of increased force on upper extremity symptoms cannot be made since the study was cross-sectional.

Lundberg and colleagues (1999) also provided indirect support for the workstyle concept and model in their study of psychophysiological stress responses in supermarket cashiers. Participants in this study were employed in cashier tasks involving the repeated motions of dragging items across a barcode scanning device or manually typing the product information into the cash register. During these tasks, measurements of EMG activity in the trapezius region, blood pressure, and heart rate were collected. Participants also provided self-report ratings of musculoskeletal pain tension and stress experienced both at work and at home. For the outcome

measures, participants with upper extremity symptoms were compared to those without symptoms. The investigators found that participants with symptoms had significantly higher levels of EMG activity in response to the task when compared to those without symptoms, but the differences in EMG responses was not found during rest periods (Lundberg et al., 1999). The results of this study support the workstyle model by providing evidence that symptomatic individuals produce increased muscle tension in response to work demands when compared to asymptomatic individuals.

Haufler and colleagues (2000) conducted a cross-sectional survey study to directly examine the association between certain features of workstyle (along with psychosocial stressors) and upper extremity symptoms in 124 office workers. The survey queried respondents regarding how often they “continue working in a way that contributes to pain and discomfort in an effort to ensure high quality” and “how long do [they] work before taking a break.” Regression models from this study demonstrated that continuing to work in a painful manner, in addition to job stress was predictive of pain intensity and functional limitations. This study was the first to directly examine the “workstyle-pain link” and the authors reported that the results should be viewed with caution due to the limited measurement of the workstyle construct. The authors recommended that a more complete measure of workstyle should be developed so that more comprehensive examinations of the association between workstyle and WRUE symptoms could occur (Haufler, Feuerstein, & Huang, 2000).

Development of the Workstyle Measure

More comprehensive investigations into the relationship between workstyle and WRUEDs have been hampered by the absence of a measure of workstyle. Until recently, only indirect measures of workstyle, such as keyboard force and a few self-report items were

available. To address this limitation and to enable more complete investigations into the effect of workstyle on WRUEDs, a measure of workstyle was developed (Feuerstein et al., 2003). This measure was developed to incorporate the components of workstyle (as conceptualized by Feuerstein, 1996 and Feuerstein et al., 1999) so that investigations into the relationship of workstyle and WRUEDs could be conducted, as well as for guiding interventions targeting workstyle. The inclusion of workstyle in the development of effective prevention and management strategies enables a focus on many of the proposed risk factors for WRUEDs, such as the psychosocial stressors, ergonomic exposures and their interactive effect on the individual's responses. The measure was developed using 136 test items generated from focus groups of office workers, ergonomists, physicians, and occupational therapists. These workstyle test items were placed on an online survey along with self-reported measures of job stress, ergonomic risk, and clinical outcomes including pain, symptoms, functional limitation, and general physical and mental health. A total of 282 participants completed the online survey and their responses were used to develop and validate the workstyle measure.

The workstyle survey was reduced to 91 total items via factor analyses and the measure consisted of six "Characteristic Responses to Work" subscales and four subscales related to "Reactivity to Increased Work Demands." Among the Characteristic Response to Work subscales, the Working Through Pain subscale accounted for 26.2% of the variance among the items, the Social Reactivity subscale accounted for 7.18%, the Limited Workplace Support subscale accounted for 4.64%, the Deadlines/Pressure subscale accounted for 3.67%, the Self-imposed Workpace/Workload accounted for 3.42%, and the Breaks subscale accounted for 2.68% of the variance. Among the Reactivity to Increased Work Demands subscales, the Mood subscale accounted for 17.44% of the total variance among items, the Pain/Tension subscale

accounted for 6.23%, the Autonomic Response subscale accounted for 3.66%, and the Numbness/Tingling subscale accounted for 3.35% of the total variance.

The workstyle survey subscales demonstrated moderate to high internal consistency (α=0.61 to 0.91, *N*=282) and test-retest (3 weeks) reliability (*r*=0.68 to 0.89, *n*=143). Higher subscale scores and total workstyle scores were significantly associated with pain, functional limitations, and adverse mental and physical health (Table 1). The workstyle total score was also independently associated with the presence of WRUE symptoms (*OR*=2.51; 95% *CI*=1.18 – 5.38) along with ergonomic (*OR*=2.59; 95% *CI*=1.25-5.36) and job stress factors (*OR*=0.73; 95% *CI*=0.34-1.58) in a logistic regression model controlling for social desirability, which was also shown to be univariably related to WRUE symptomatic case status (see Table 1).

Insert *Table 1* about here

Subsequent path analyses using the workstyle measure were conducted to test the Feuerstein and colleagues' (1999) workstyle model (Nicholas, Feuerstein, & Suchday, 2004). The path analyses demonstrated that the workstyle model, using the workstyle total score, self-reported ergonomic risk exposures, and work demands including total workload and workload variability, prospectively predicted pain (*AGFI*=0.90), symptoms (*AGFI*=0.85), and functional limitations (*AGFI*=0.90) reported by participants (*N*=169) 12 months after their initial participation in the workstyle measure development survey (Nicholas et al., 2004). These results support the hypothesis that targeting workstyle in an intervention may be useful in the secondary prevention of WRUE symptoms.

WRUED Intervention Strategies

Despite the evidence regarding the risk factors for WRUEDs and models of the proposed processes, many of the intervention efforts remain focused on addressing a single aspect of the

problem, such on the ergonomic environment or on stress management. These strategies often result in limited improvements that do not persist (NRC, 2001). However, recent evidence (i.e., Bernacki et al., 1999; Lincoln et al., 2000) has indicated that multicomponent interventions aimed at primary prevention (prior to experiencing the condition of concern and aimed at reducing risk factors) and/or secondary prevention (after experiencing the condition of concern with a focus on rehabilitation and prevention of disability) of WRUEDs may be more successful than tertiary prevention (after significant loss of function and aimed at achieving maximal functional capacity within the limitations of the impairment; NRC, 2001). A brief examination of intervention strategies, beginning with a discussion of the medical management of WRUEDs, highlights this trend toward more comprehensive intervention and prevention strategies.

Medical Management

Medical management of WRUEDs advocates a conservative approach toward treating these disorders (Piligian et al., 2000). Early treatment for the symptoms of the various disorders involves rest from the work task, splinting and/or immobilizing the affected area to maintain neutral biomechanical postures, cold or heat applications, and non-steroidal anti-inflammatory (NSAIDs) medications (Peate, 1994; Terrono & Millender, 1996; Herbert, Gerr, & Dropkin, 2000; Mani & Gerr, 2000; Piligian et al., 2000). When symptoms persist after these initial treatments have been used, more extreme work restrictions are employed, as are the use of other medications, such as tricyclic antidepressants to assist with pain management (Piligian et al, 2000; Marshall, 2002). Additional treatment options include deep tissue massage, occupational and/or physical therapy, and strengthening exercises aimed at reducing symptoms and/or improving function through reducing muscle tension and maintaining range of motion (Piligian et al., 2000; Mani & Gerr, 2000).

If these conservative medical management options do not resolve symptoms and/or the symptoms worsen, more invasive measures, such as corticosteroid injections, are used, followed by surgical treatment (Piligian et al., 2000; Herbert et al., 2000). However, surgical options are considered to be applicable only if conservative therapy has failed (Mani & Gerr, 2000). Feuerstein and colleagues (1999) conducted a 12-year review of outcomes in the clinical management of carpal tunnel syndrome, examining surgical treatments and steroid injections (in addition to non-invasive management strategies), which demonstrated that both endoscopic and open carpal tunnel release procedures are do improve function, with endoscopic procedures demonstrating a more rapid return to work rate. However, there is little evidence to suggest that long-term pain reduction and functional improvement occur following surgery. Furthermore, this review also showed that steroid injections and splinting may be just as effective in improving return to work times (Feuerstein, Burrell, Miller, Lincoln, Huang, & Berger, 1999). Additionally, although studies have shown that medical management is often associated with at least short-term improvements in symptoms and functioning, there is significant agreement that medical options are less successful for WRUEDs unless other conditions, such as the ergonomic aspects of the task and/or any psychosocial factors, are addressed (Terrono & Millender, 1996; Herbert, Gerr, & Dropkin, 2000; Mani & Gerr, 2000; Piligian et al., 2000). Mani and Gerr (2000) advise that treatment without control of work conditions that led to the disorder is likely to fail.

Ergonomic Interventions

Because of the need to address aspects of the workplace to improve the treatment outcomes of medical management, as well as the evidence that has indicated that prevention of WRUEDs is more successful and cost-effective than the treatment of advanced disorders (NRC,

2001), considerable attention and effort has been directed to workplace intervention efforts. Ergonomic interventions in particular have been employed and tested most extensively, perhaps because these interventions are intended to reduce the biomechanical and other physical risk factors that are direct sources of tissue loading and compression. Ergonomic interventions typically involve one or more of the following (as applicable/available): evaluation of the current workstation and/or tasks, modification of the workstation design or task procedures to avoid prolonged static loading, awkward postures, or repetitive motions, replacement of poorly designed equipment with ergonomically-sound equipment intended to maintain neutral body positions, and/or educational information, either via training or via written literature (NIOSH, 1997).

Ergonomics programs have become a primary choice for conservative, nonsurgical treatment of WRUEDs and typically involve the redesign of equipment to increase more neutral postures and/or ergonomics education and training (Terrono & Millender, 1996; Herbert, Gerr, & Dropkin, 2000; Mani & Gerr, 2000; Piligian et al., 2000). A computer keyboard study conducted by Tittiranonda and colleagues (1999) is a prime example of a traditional ergonomic redesign intervention. This prospective, randomized controlled study examined the effects of using alternative geometry keyboards designed to decrease lower arm and wrist deviations from neutral postures. Eighty individuals with upper extremity disorders were assigned to one of four groups: Apple Adjustable Keyboard™ (kb1), Comfort Keyboard System™ (kb2), Microsoft Natural Keyboard™ (kb3), or a placebo conditions where individuals brought in their own work keyboards which were not modified but had a label affixed stating that the computer had been modified for study purposes. All subjects used their assigned computer keyboards at work for 6 months. Additionally, individuals were given education about identifying ergonomic risk factors

and furniture modification to improve postures. Workstation adjustments were also made for each participant. After the 6-month study, a significant trend toward reduced pain was found for alternative keyboard use with significant pain reductions in kb3 compared to placebo, whose members were least likely to report improvement in symptoms. Kb3 users reported significantly greater improvements in functioning when compared to placebo. Also, the temporal pattern of pain severity also indicated that only users of kb3 reported significantly less pain at 18- and 24-week follow-up periods. Although users of the other two reported some improvement in pain and functioning, these improvements were not significantly different from baseline or the placebo condition. The subjective improvements in pain and functioning were associated with increased satisfaction with the keyboards, but did not correspond to objective clinical improvements in medical evaluations. This disparity, combined with some limitations of the study (i.e., dropouts, lack of sensitive objective measures, etc.) led the authors to conclude that replications of this study were required, but that computer users may experience a reduction in symptoms of WRUEDs with the use of the kb3 keyboard (Tittiranonda, Remple, Armstrong, & Burastero, 1999).

An example of a growing trend toward more comprehensive ergonomics programs is a randomized controlled study conducted by Ketola and colleagues (2002) to compare different ergonomic intervention programs for users of video display units. In this study, 124 individuals were randomly assigned to one of three intervention conditions: intensive ergonomics, where individuals were given an ergonomics workstation checklist and completed participatory modification of their workstations with the help of physiotherapists and learned about appropriate work postures and the importance of rest breaks; ergonomic education, where individuals attended a 1-hour training session regarding the principles of ergonomics in VDU

work and received the same checklist as the intensive ergonomics participants; and lastly, a reference group who received only a one-page leaflet with general information regarding musculoskeletal health related to VDU work. After 2 months, participants in both the intensive ergonomics and education conditions reported significantly less daily discomfort in the upper extremities than the reference group. At the 10-month follow-up period, both the intensive ergonomic groups and education groups reported lower symptoms ratings than the reference group; however, no significant group differences were found at 10 months among the three groups. The authors conclude that although long-term effects were not found, short-term improvements in upper extremity symptoms can be achieved through both intensive and educational intervention programs (Ketola et al., 2002).

Bernacki and colleagues (1999) also conducted a workplace ergonomics program aimed at reducing WRUEDs. Although this study is not representative of a controlled experiment, this naturalistic study of an ergonomics program in a workplace demonstrated that these interventions can be useful in the prevention of upper extremity problems. The program employed a multidisciplinary approach that included a workplace ergonomics modification, a medical assessment and splinting of the upper extremity as necessary, physical therapy for patients who were non-responsive to splinting, and job restrictions or organizational modifications to allow the individual to rest and/or perform alternative duties until symptoms remitted. This program resulted in significant reductions in WRUED presentations/diagnoses and WRUED-related surgeries (Bernacki, Guidera, Schaefer, Lavin, & Tsai, 1999). The three ergonomics intervention studies reviewed here are representative of the literature in this area and suggest that the employment of ergonomically-sound equipment is desirable for reducing WRUEDs (i.e., Tittiranonda et al., 1999), but that improvements can occur through the modification of the

existing workstation/equipment (i.e., Ketola et al., 2002). However, there is some evidence to suggest that these efforts are more successful when conducted in a comprehensive, multidisciplinary manner to best suit the individual (i.e., Bernacki et al., 1999). Also, these results must be viewed with some caution due to the inability to rule out non-specific effects such as passage of time, regression to the mean, and attention/Hawthorne effects.

More comprehensive reviews of the literature regarding ergonomics interventions for WRUEDs have resulted in similar conclusions. Despite some evidence regarding the efficacy of ergonomic management strategies, the sole use of ergonomic modification and education strategies may not be sufficient for addressing the problem of WRUEDs. For example, although a review of the several ergonomic treatment case studies provided some evidence that ergonomic interventions reduced the occurrence of WRUEDs (Viikari-Juntura, 1998), an evidence-based systematic review of 15 controlled studies examining conservative treatment options for repetitive strain injuries of the upper extremity (characterized by symptoms and/or disorders) found more limited evidence for the effectiveness of ergonomic programs (Konijnenberg, de Wilde, Gerritsen, van Tulder, & de Vet, 2001). This systematic review suggested that ergonomic interventions produced some symptom relief and improvement in functioning, as did exercise, multidisciplinary rehabilitation, and soft tissue therapy. Despite this, no strong evidence was found for any treatment option, and the authors caution that the results of the review must be viewed with caution due to methodological confounders (i.e., non-blinded conditions and/or outcomes) and possible bias (i.e., non-specific effects such as time and attention factors) in many of the included studies (Konijnenberg et al., 2001).

Lincoln and colleagues (2000) examined biomechanical/ergonomic interventions for the primary prevention of work-related upper extremity disorders. This systematic review included

24 total studies involving engineering changes (i.e., keyboard/mouse redesign), personal interventions (i.e., splint-wearing, training, exercise), or "multiple component" (i.e., programs comprised of one or more of the following: redesign/modification, training, and task rotation, restricted duty) interventions including asymptomatic workers to determine which interventions were most effective. The personal and engineering interventions were shown to be minimally effective in primary prevention efforts. The most promising evidence was that that the multi-component interventions (programs with more than one intervention target) in the review were correlated with a decrease in the incidence of WRUEDs including carpal tunnel syndrome, tendonitis, lateral/medial epicondylitis, and other conditions. The authors concluded that these multiple component interventions "may represent the best opportunity to reduce risk" in primary prevention and perhaps may be equally or more relevant for secondary prevention efforts in office workers (Lincoln et al., 2000).

Stress Management Interventions

Along with the growing evidence that multicomponent/multidisciplinary ergonomic interventions may be useful in the overall management and prevention of WRUEDs, there is growing evidence that ergonomic interventions alone are not sufficient for dealing with these disorders and that addressing psychosocial aspects of the workplace may be a useful adjunct to ergonomics programs (NRC, 2001). The identification of psychosocial stress as a risk factor for WRUE symptoms and disorders (i.e., Bongers et al., 2002) and the development of models of stress and its contribution to WRUEDs (i.e., Huang et al., 2002) have led to an interest in interventions that address the psychosocial aspects of the development of WRUE symptoms and disorders. In general, these stress management interventions either intervene on an organizational-level to reduce workplace stress, or on an individual-level to improve stress

management and prevention (Elkin & Rosch, 1990). However, there is evidence that these interventions often overlap, and the effects of an intervention on one level (i.e., individual stress management – helpseeking training) can have effects on the other level (i.e., organizational sources of stress- supervisor/coworker support; van der Heck & Plomp, 1997).

Organizational interventions involve modification of aspects of the workplace including the organizational structure, training, tasks, and/or administrative support (Elkin & Rosch, 1990; van der Hek & Plomp, 1997). However, there are relatively few organizational evaluations, and the evidence regarding the effectiveness of organizational stress reduction interventions is limited. The reasons for this low number of studies is unclear, however, van der Hek and Plomp (1997) caution that a methodologically sound intervention at the organizational level is difficult to implement. This difficulty may stem from many factors including the need for overall managerial support of the intervention, such as allowing for the potential for changes in business and administrative practices, and the time and financial burdens associated with these changes. In their rigorous review of evidence-based studies targeting occupational stress, van der Hek and Plomp (1997) were able to find only two studies with organizational-level interventions that met their inclusion criteria regarding scientific rigor. Both studies included interventions that included organizational stress assessments, administrative/managerial changes involving senior leadership and representative working groups aimed at improving the organizational climate for assistance with stress, and limited training for individual stress management. These studies evaluated the effectiveness of their interventions on organizational measures of productivity, turnovers, absenteeism, and health insurance costs, as well as individual measures including self-reported stress, mood, and job satisfaction. Despite the limited representation of organizational

studies, the reviewed studies suggested that organizational interventions for reducing stress yielded the best results on individual and organizational outcomes (van der Hek & Plomp, 1997).

In contrast, in their review, Briner and Reynolds (1999) describe the theoretical and empirical evidence regarding organizational interventions and caution that the data are mixed, and that organizational-level interventions are not likely to be a complete answer to the occupational stress problem. This caution is echoed in a recent review conducted by Reynolds (2000) who found nonsignificant effects for organizational interventions on individual well-being and organizational outcomes. Similarly, in a meta-analysis conducted by van der Klink and colleagues (2001), a nonsignificant effect was found for organization-focused interventions in reducing stress-related outcomes (d=0.08). Also, the realities regarding the difficulty to implement organizational interventions and the possibilities of workplace changes (i.e., due to managerial/employee turnover) or relocations to organizations without such interventions point to the need to implement individual-level stress management interventions as well.

Individual-level stress management interventions usually involve training the individual to manage their stress responses and/or working habits that may contribute to stress (Elkin & Rosch, 1990). Examples of individual stress management interventions include teaching relaxation skills, cognitive coping strategies, time management, assertiveness training, and/or physical fitness skills (Elkin & Rosch, 1990; van der Hek & Plomp, 1997). There are many more individual-level stress management studies than there are organizational intervention evaluations (van der Hek & Plomp, 1997), and there is research regarding the effects of each type of individual stress management interventions. In his review of stress management in work settings, Murphy (1996) found that meditation, cognitive-behavioral skills training, and progressive muscle relaxation all had positive effects across stress outcomes, such as

physiological stress responses (i.e., blood catecholamine levels, blood pressure), mood/anxiety reports, job satisfaction, and somatic complaints. However, the most effective stress-management interventions, especially for somatic complaint outcomes, included a combination of two or more techniques, with the combination of cognitive-behavioral skills training and progressive muscle relaxation yielding the best overall results (Murphy, 1996). In their meta-analysis of workplace stress interventions, van der Klink and colleagues (2001) found moderate effects for cognitive-behavioral (d=0.68) and multimodal (using active and passive coping skills) interventions (d=0.51) and a small effect for relaxation techniques (d=0.35) in general for outcomes including quality of work, psychological responses, and physiological responses.

Although there is a large body of evidence relating to stress management on general stress-related outcomes, there is relatively little evidence regarding the effects of stress management on WRUE symptoms, specifically. One of the few controlled studies in this area was conducted by Spence (1989), who examined individual cognitive-behavioral treatment in comparison to group cognitive-behavioral treatment and wait-list control conditions for individuals with chronic WRUE pain. This study demonstrated that both cognitive-behavioral treatment modalities were equally effective and superior in reducing upper extremity pain, interference with daily functioning, and self-reported distress relative to the non-treatment condition, whose members did not show any such improvement (Spence, 1989). Additionally, at 2 years post-treatment, members of both cognitive behavioral conditions reported improvements over baseline levels of pain and distress; however, very few participants reported to be pain-free (Spence, 1991).

Pransky and colleagues (2002) conducted a systematic review of interventions that included job stress reduction for managing WRUEDs. Unlike previous reviews, which examined

stress management interventions to reduce workplace stress in general, the Pransky et al. review focused more narrowly on studies that examined WRUED symptomatic outcomes and job stress. The review suggested that individual-focused stress management interventions improved self-reported stress and upper extremity symptoms, especially when combined with other elements, such as ergonomic training and interventions. However, the authors did not conduct statistical evaluations to provide data on this conclusion. Rather, the authors asserted that this body of research is currently at an early stage of development and called for more methodologically sound studies to provide better evidence regarding stress management interventions on WRUED outcomes (Pransky, Robertson, & Moon, 2002).

The Pransky et al. (2002) review, along with others cited earlier (i.e., Murphy, 1996) suggests that interventions with multiple strategies/targets may be more effective approaches for managing health outcomes. This assertion is supported by growing theoretical and research evidence that the combination of stress management and ergonomic risk reduction may be the best approach for preventing and/or managing WRUE symptoms and disorders. In a review of 13 studies regarding stress and general health in bus drivers, the authors found that secondary preventive programs reduced subjective and physiological measures of job stress and sickness absenteeism (Kompier, Aust, van den Berg, & Siegrist, 2000). The authors further hypothesized that preventive programs combining multiple intervention categories including ergonomics, social work environment, and person-directed interventions may be the most powerful for reducing occupational stress, which is a multi-causal phenomenon (Kompier et al., 2000).

The suggested utility of multicomponent interventions is further supported by studies in other populations of workers. One example is a study by Feuerstein and colleagues (2000), who conducted an uncontrolled group intervention study for sign language interpreters with WRUE

symptoms. The intervention program in this study included reducing risky biomechanical behaviors; improving physical fitness; managing job stress and musculoskeletal pain; and providing education relating to stress, pain, and medical utilization. This multicomponent intervention appeared to be successful in reducing the number upper extremity cases and health care and indemnity costs for over 2 years post-treatment (Feuerstein, Marshall, Shaw, & Burrell, 2000).

Similarly, Feuerstein and colleagues (1993) conducted a multidisciplinary intervention for workers with chronic upper extremity disorders that included daily exercise/physical conditioning (with aerobic, stretching, and strengthening components), work conditioning/simulation to reduce fear of reinjury and teach safe work practices, work-related pain and stress management (with relaxation, cognitive coping, sensory alteration, communication, and problem-solving components), ergonomic consultation (with assessment and suggested modifications), and vocational counseling/placement for those unable to return to their previous job. Participants in the multidisciplinary intervention were compared to a reference group of individuals receiving usual care (management by primary care, typically involving physical therapy, pain treatment, rehabilitation counseling, etc.) who were similar to the treatment group in terms of measures of disability, pain, fear of reinjury, psychological distress, and sociodemographic factors. The results of the study indicated that at 17-18 months post-treatment, 74% or the treatment group returned to work in some capacity as compared to 40% of the control group ($p<0.05$), suggesting that this multidisciplinary program resulted in long-term improvements over usual care (Feuerstein et al., 1993). These studies provide promising evidence that because WRUEDs are hypothesized to be multifactorial in cause, the most beneficial management strategies are likely to be those that address the multiple

components of the ergonomic and psychosocial stressors of the work environment and their interaction with the individual worker's own characteristics (NRC, 2001). An additional next step that may be even more beneficial is the inclusion of targeted interventions directed at components of risk factors that are identified to be most relevant and/or specific to a particular individual. The workstyle measure may be a resource to guide the identification of and intervention on individually relevant intervention targets for WRUE symptoms and disorders.

Developing a Workstyle-Based Intervention

The workstyle model and the new workstyle measure provide a promising new direction to address the need for multicomponent interventions, particularly because the model addresses the interactive ergonomic, psychosocial, and individual factors of the workplace, which may lead to or exacerbate WRUEDs (Feuerstein, 1996; Feuerstein et al., 1999). The workstyle model provides a framework for interventions that address all three components (ergonomic, psychosocial, and individual), as is suggested by the evidence that exists in the WRUED literature at this time (i.e., NRC, 2001). Additionally, the development of the workstyle measure enables an individualized intervention strategy within the workstyle model framework by identifying the cognitive-behavioral risk factors of workstyle that are relevant for each individual and addressing these in the combined context of ergonomic and general stress management modifications. An examination of the workstyle measure subscales is particularly useful for understanding the cognitive, behavioral, and physiological components of the workstyle construct that occur in response to increased work demands, often under conditions of exposure to ergonomic and psychosocial risk factors. The identification of the subscale factors should guide interventions to appropriately address a worker's responses that elicit and/or maintain an

adverse workstyle. Individually tailored intervention plans can be designed based on the workstyle subscales that are most relevant (e.g., produce the highest scores) for that individual.

The first subscale, Working Through Pain, captures a construct relating to the tendency to work despite the presence of pain and/or WRUED symptoms and encompasses items similar to the "working in a painful way to ensure quality" item used in the Haufler et al. (2000) study. The Working through Pain subscale can be conceptualized as a measure of behavioral exposure to ergonomic risk factors associated with WRUEDs. Potential interventions that can be directed at this subscale include education, problem solving, and other practice exercises to limit reaches beyond an ideal working space and movements that are done with excessive force and/or speed. This kind of modification is recommended for an ergonomics program (i.e., Piligian et al., 2000); and education, problem solving, and increasing awareness of the effects of biomechanical motions on WRUE symptoms have been shown to be successful in the reduction of WRUE cases and associated costs (Feuerstein et al., 2000b). Additional examples of behavioral modifications related to this subscale will include taking rest breaks and monitoring one's posture and pain/symptoms as cues to engage in rest breaks and relaxation exercises. Rest breaks and relaxation techniques (i.e., progressive muscle relaxation) have been shown to be useful for reducing upper extremity pain and symptoms (NRC, 2001; Spence, 1989; Spence 1991; Dababneh, Swanson, & Shell, 2001; Galinsky & Swanson, 2000).

The Social Reactivity subscale relates to fears of making mistakes and evaluation apprehension related to the workplace. The Social Reactivity subscale can be conceptualized as consisting of some of the cognitions that serve to drive the unhealthy behavior described in the Working Through Pain subscale out of fear of negative consequences at work. The items in this subscale are similar to those that described as socially prescribed perfectionism, where standards

are perceived as being imposed by external sources and there is a strong desire to gain approval and/or a fear of negative evaluation (Shafran & Mansell, 2001). A similar subscale is the Self-Imposed Workpace/Workload subscale, which relates to the dimension of self-oriented perfectionism. Self-oriented perfectionism is the practice of demanding of oneself or others a higher standard of performance than is required by the situation (Shafran & Mansell, 2001). Both factors in these subscales result in self-generated workplace stress.

The goal for improvement related to these subscales is to reduce the self-generated stress regarding these workplace concerns through cognitive-behavioral techniques. There are few studies available at this time that examine treatments for perfectionism, although perfectionism has been shown to be associated with somatic symptoms (Shafran & Mansell, 2001). A clinical review of the perfectionism literature found only one treatment study (a compilation of nine individual cases a social work setting) and one untested treatment handbook (Shafran & Mansell, 2001). Therefore, the authors recommend a cognitive-behavioral approach based on a cognitive-behavioral conceptualization of perfectionism, the modification of perfectionistic thinking in other disorders (i.e., depression and eating disorders) and the limited successes from the treatment study that used cognitive-behavioral techniques to modify perfectionistic thoughts in a small group of participants (Shafran & Mansell, 2001; Shafran, Cooper, & Fairburn, 2002; Ferguson & Rodway, 1994). The specific interventions related to the Social Reactivity and Self-Imposed Workpace/Workload subscales include challenging and modifying perfectionistic thoughts via techniques such as thought records/diaries, examining the evidence for the thoughts, and generating plausible alternatives. These thought modification techniques have been shown to be effective in reducing subjective distress (Beck, 1995) and WRUE symptoms (Spence, 1989).

The next two subscales appear to be similar to psychosocial stressors identified elsewhere as risk factors for WRUE symptoms (e.g., Fredriksson et al., 1999; Bongers et al., 2002). The Limited Workplace Support subscale relates to a perceived lack of coworker support/social support and lack of supervisor support, in addition to aspects of job stress (i.e., equipment problems). Training for coping strategies related to this factor may include teaching reasonable assertive communication and help-seeking skills in the work place and practicing these skills with others. Similar help-seeking and assertive communication skills have been shown to be effective in reducing pain and distress both for musculoskeletal symptoms (Linton, 2002; Spence, 1991) and for general stress management (van der Klink et al, 2001; Firth-Cozens, 2000; Reynolds, 2000; D'Zurilla, 1990). The Deadlines/Pressure subscale relates to time pressure. Time pressure, such as feeling rushed and/or not having enough time to complete all demands was found to be related to musculoskeletal symptoms in workers (Huang, Feuerstein, Kop, Schor, & Arroyo, 2003). Individuals who score highly on the Deadlines/Pressure scales may reduce their levels of distress at work and improve job satisfaction through interventions in time management skills (suggested to be effective in a study by Orpen, 1994), and through problem-solving and assertive communication skills, which have both been shown to be useful in reducing upper extremity symptoms and distress (Spence, 1991). Overall, interventions for both groups may include time-management skills for more efficient work habits, as well as practicing assertive communications regarding setting limits and asking for help from others, especially supervisors (Linton, 2002; Firth-Cozens, 2000; Reynolds, 2000; Spence, 1991).

The Breaks subscale is another behavioral aspect of workstyle where cognitions such as fear of negative evaluation or perfectionism standards often prevent rest and maintain adverse work behaviors, postures, etc. This subscale specifically addresses health behaviors relating to

breaks and rest. Numerous studies have shown that adding more frequent, self-managed rest breaks improve discomfort without an adverse impact on productivity (i.e., Dababneh, Swanson, & Shell, 2001; Galinsky & Swanson, 2000; Henning, Jacques, Kissel, Sullivan, & Alteras-Webb, 1997). Group members will be given education about breaks, "microbreaks," stretching, and the importance of rest. Problem-solving and idea-generation about times and ways to take breaks/get rest will be conducted to ensure that each individual is able to enjoy and/or be motivated for taking breaks according to what each person finds reinforcing (i.e., coffee break, stretching time, phone calls).

The last four subscales (Mood, Autonomic Response, Numbness/Tingling, and Pain/Tension) are indications of the symptoms that occur in response to increased job demands and are associated with an adverse workstyle. Individuals can be taught to recognize their specific symptom reactions to periods of increased work demands and to use these symptoms as "red flags" for "working through pain" or other workstyle-related risk factors. Relaxation techniques also can be taught to all participants to reduce physical symptoms and perceived stress. Relaxation exercises (i.e., progressive muscle relaxation, deep breathing, etc.) have been shown to reduce subjective feelings of stress (i.e., van der Klink et al., 2001; Murphy, 1996), physiological stress responses, such as blood pressure and salivary cortisol (i.e., Pawlow & Jones, 2002) and upper extremity musculoskeletal pain (Spence, Sharpe, Newton-John, & Champion, 1995).

Overall, the workstyle subscales encompass a variety of responses, both cognitive and behavioral, to workplace demands and stressors. Therefore, an intervention that addresses the aspects of workstyle described above represents a multimodal intervention strategy and, in conjunction with ergonomic modifications, may be a highly effective management technique.

This type of comprehensive intervention program involving ergonomics and specific, individualized stress management and cognitive-behavioral skills training/behavior modification to address adverse workstyle responses has not been designed or tested to date. This kind of intervention is a next logical step in the WRUED intervention literature and attempts to address several identified risk factors related to the etiology, exacerbation, and maintenance of WRUE symptoms and disorders.

Specific Aims

The present study examined the effects of a workstyle-directed intervention for the secondary prevention of WRUE symptoms. This study was the first intervention targeted at those components of workstyle that are associated with WRUE pain, symptoms, and functional limitation (see Table 1), and enabled office workers to identify their own specific workstyle factors. The present study was a secondary prevention (targeting workers already experiencing symptoms) rather than a primary prevention (targeting workers who are asymptomatic) effort for several reasons. First, changes in symptom and function status were expected to be indications of the effectiveness of the interventions under study for managing symptoms, as opposed to primary prevention where the onset of symptoms is difficult to predict and explain because of the still unclear epidemiology of these problems (NRC, 2001; Punnett & Wegman, 2004). Secondly, it was expected that individuals already experiencing symptoms would be more motivated to participate in a study requiring the loss of personal time (i.e., lunch break) in an effort to gain relief from their symptoms. Finally, workstyle has been found to be related to the exacerbation and maintenance of symptoms (i.e., Feuerstein et al., 2004; Nicholas et al, 2004), but there is no current evidence linking workstyle to the onset of WRUES/Ds.

This study compared an ergonomic intervention, which is the current standard of conservative treatment according to consensus (i.e., NRC, 2001; Piligian et al., 2001), a workstyle intervention based on the modifications discussed above for the workstyle subscales, a combined ergonomic and workstyle intervention condition, and a wait-list control condition where participants did not receive ergonomic intervention or workstyle interventions. However, the participants in all four groups were free to access usual modes of health care. Participants were queried via surveys regarding their physical symptoms, subjective levels of job stress, physical health, functional limitation, and ergonomic exposures in the workplace at baseline and post-test, and again at a 3-month follow-up period to determine the short-term durability of treatment effects. Additionally, objective ratings of ergonomic exposure were collected from participants by an evaluator trained to conduct ergonomics assessments using a standard computer workstation checklist. This study provided evidence for the importance of combined treatments including workstyle as an intervention target (ergonomic and psychosocial with workstyle).

Hypotheses

The following hypotheses were proposed:

<u>Process Hypotheses</u>

1) Participants in the workstyle-only and combined workstyle-ergonomics conditions will report significantly lowered (less adverse) workstyle ratings from baseline and compared to the ergonomics-only and wait-list control conditions at post-test and 3 months.
2) Participants in the ergonomics-only and combined workstyle-ergonomics conditions will report significantly reduced ergonomic risk ratings on both observed and self-report

measures compared to the workstyle-only and wait-list control conditions at post-test and at 3 months.

3) Participants in the workstyle-only, and combined workstyle-ergonomic conditions will report significantly reduced job stress ratings from baseline at post-test compared to the ergonomics-only and wait-list control conditions at post-test and 3 months.

<u>Outcome Hypotheses</u>

1) The combined treatment including both workstyle and ergonomic interventions will result in the greatest improvement in WRUE symptoms, functional limitation, and general physical and mental health in comparison to ergonomics-only intervention, workstyle-only intervention, or wait-list control conditions at post-test. Both the ergonomics-only and workstyle-only interventions will produce greater improvements in WRUE symptoms, functional limitation, and general physical and mental health outcomes in comparison to the wait-list control at post-test. Neither the ergonomics-only nor the workstyle-only interventions will produce the same level of improvements as the combined intervention condition. Additionally, because each of these interventions modified only one of the multiple proposed risk factors for WRUE symptoms, the ergonomics-only and workstyle-only conditions will not be significantly different from each other in terms of outcome improvements.

2) All outcome improvements for the combined workstyle-ergonomics intervention, the ergonomics-only intervention, and the workstyle-only intervention will persist at the 3- and 12-month follow-up periods. The combined intervention participants will report significantly better outcomes than the ergonomics-only, workstyle-only, or wait-list control groups at 3 months. The workstyle-only and ergonomics-only conditions will not

significantly differ from each other at follow-up, but will remain significantly improved in WRUE outcomes in comparison to the wait-list control group.

METHODS

Participant Recruitment and Inclusion Criteria

Office workers with pain, tension, numbness, or other symptoms in the upper extremity were recruited from a major insurance company in the Midwest to participate in an intervention effort involving workplace ergonomic risk reduction and workstyle modification. Recruitment was conducting using fliers posted at the office location and via an email with the same information that was on the flyer. It is important to note that the desired population for inclusion in this study was <u>office workers who were reporting WRUE symptoms, but are continuing to work full-time</u>. Participants were screened for factors that may confound the reporting of symptoms that developed in relation to work (i.e., injury, arthritis, diabetes, etc.; Atcheson et al., 1998; Soloman et al., 1999) or may confound the subjective experience of pain and symptoms (i.e., depression and anxiety; Magni et al., 1994; Nahit et al., 2003). Study inclusion criteria were as follows:

1) work on computers a minimum of 4 hours per day
2) employed at least 32 hours per week
3) self-reported presence of symptoms (pain, aching, stiffness, burning, tingling, and/or numbness) in the fingers, hands, wrists, forearms, elbows, shoulders, and/or neck that occurred at least twice a month and lasted 2 or more days during the past year.

4) symptoms not related to an accident and/or injury in the upper extremity (e.g., sports, motor vehicle accident, etc.)
5) female participants were not pregnant and had not been pregnant in the past year
6) no diagnosis of inflammatory arthritis, thyroid disease, or diabetes mellitus
7) participants reported a Beck Depression Inventory score less than 20 and a Beck Anxiety Inventory score less than 16 at screening.

All participants completed baseline, post-test, and 3-month follow-up assessments of self-reported workstyle, job stress, ergonomic risk, pain, symptoms, functional limitations, general physical and mental health, and sociodemographic information. Participants provided informed consent prior to participating in the study and were paid $10 for the completion of surveys at each of the assessment periods. Based on a priori power analyses (Table 2) using estimates from a similar study conducted by Spence (1989), a target recruitment of 20 participants per group (80 total participants) was determined.

Insert *Table 2* about here

Intervention Groups

Workers who met inclusion criteria were randomly assigned to one of the four treatment conditions:

1) <u>Ergonomic Intervention (EI):</u> Participants received only ergonomic consultation, education, and modification to workplace; and were not provided with any workstyle modification or education. This condition represented the current standard practice for conservative management of WRUEDs at this time (i.e., “best available”/“gold standard” control condition).

2) Workstyle Intervention (WI): Participants attended 3 workstyle modification workshops (once a week for 3 weeks) and were not provided with any ergonomics modification or education. This condition evaluated the independent effect of workstyle modification.

3) Workstyle and Ergonomic Intervention (WEI): Participants received ergonomic consultation, education, and modification to workplace and attended 3 workstyle modification workshops (once a week for 3 weeks). This condition represented the combined and targeted intervention strategy that was hypothesized to be a more effective WRUED prevention method according to the empirical literature reviewed earlier.

4) Wait-List Control (WLC): Participants did not attend workstyle modification workshops and were not provided with any ergonomics modification or education, but were not prevented from accessing usual care. This condition represented a "usual care" control to account for non-specific effects such as time and Hawthorne effects. After 12 months, participants in the WLC will receive the most efficacious treatment from the study based on results from a 12 month follow-up assessment not examined in the present study. If no differences among groups are found at 12 months, participants will choose the intervention they prefer.

The nature of the different intervention conditions resulted in different numbers of personal contacts across groups (i.e., WEI received more personal contacts than the EI and WI groups). To address this potential confounder, the EI and WI groups received additional email contacts to equalize the total number of study-related contacts across participants to address

attention/Hawthorne effects. However, the wait-list control group did not receive any supplemental email contacts to avoid introducing any additional non-specific effects in this comparison condition. (See Table 3 for an overview of intervention timeline of activities and the contacts for each intervention condition.) This disparity in personal contacts is a recognized limitation of the study. Additionally, the absence of a placebo-control (i.e., attention/discussion groups) is a recognized limitation of the design. Both of these limitations are discussed in more detail below.

Insert *Table 3* about here

Screening Procedure

The researcher arranged meetings with potential participants to provide informed consent and answer any questions about the study, participation, etc. After agreeing to participate in the study, participants were screened via a Screening Form (Appendix 1). This semi-structured interview was designed to gather contact information and health information related to case inclusion criteria. Volunteers not meeting inclusion criteria were thanked for their time and excluded from this study. Participants were further screened for depression and/or anxiety disorders by completing the Beck Depression Inventory-Second Edition (BDI-II, 1996; a "moderate" score=20 or higher) and the Beck Anxiety Inventory (BAI, 1988; a "moderate" score=16 or higher) because depression and anxiety may confound the presence and/or perception (e.g., pain intensity) of work-related symptoms (Magni et al., 1994; Nahit et al., 2003) and were not specifically targeted for intervention in the present study. No participants were eliminated because of this criterion.

Individuals who met inclusion criteria were randomly assigned to one of the four treatment conditions. The block randomization process was conducted such that each participant

has an equal probability of being assigned to any of the four groups at any time. After random assignment, participants were scheduled for an ergonomics visit at the individual's worksite and/or a group meeting (WI and WEI groups only).

Participants who were randomized to a treatment condition received an initial email within 2 days with the instructions for the participant to complete the baseline survey via the world wide web. After the study's conclusion, all participants received emails to complete the post-test web survey, and at 3 months, participants received another email asking them to complete the follow-up survey on the web. Participants were paid $10 for completing each survey and these payments were mailed to the individual.

Description of Interventions

Ergonomic Intervention (EI)

The Ergonomic Intervention (EI) condition received a baseline consultation from the primary researcher, who is a masters-level ergonomics evaluator, for an evaluation of workplace ergonomic risks and for minor adjustments and modification recommendations to existing workstation layout and equipment wherever possible, according to the workplace and task. A follow-up consultation occurred as necessary at approximately 4-5 weeks after baseline. The ergonomics evaluator recommended more modifications and provided general ergonomics feedback, as applicable. For all visits, the evaluator followed a standardized checklist designed by the Washington State Department of Labor (1997). This checklist was slightly modified to include ergonomic modification recommendations to the existing workstation equipment and for clarity across raters, as reported by Dane and colleagues (2002; Appendix 3). In addition to the standardized checklist, the evaluator provided a basic ergonomic education flyer with recommendations regarding workstation design, awareness of unhealthy postures and motions,

and the importance of rest breaks. The evaluator made individualized recommendations according the workers' characteristics, tasks, and workstations, as necessary. Furthermore, the ergonomic visits were audio tape recorded and the content of the visits was reviewed using a standardized checklist by an independent reviewer who was blind to the hypotheses of the study (Appendix 4). The reviewer evaluated a random sample of the meetings using a standard rating form to ensure that ergonomic visits were reasonably standardized and addressed the appropriate material.

Each EI participant received email contacts at 1, and 2 weeks after the first ergonomic visit with a review of ergonomic principles and an encouragement to maintain modifications. At 3 weeks, participants received a final email with a summary of ergonomics principles and an encouragement to maintain modifications. A separate reminder email was sent asking participants to complete the post-test survey via the website. Participants received a standardized reminder email at 3 post-test reminding them of the ergonomics concepts they learned and asking them to complete the follow-up survey on the website (Appendix 5). This process results in a total of seven contacts (2 personal; 5 via email).

Workstyle Intervention (WI)

Individuals in the WI condition received a total of three weekly 60-minute workshop meetings relating to workstyle intervention (Treatment Manual- Appendix 6). Group meetings were held during the lunch hour (12:00pm to 1:30pm) on Monday through Thursday for a total of four groups. Attendance was taken at each meeting and make-up meeting were held for participants who were unable to attend a meeting. Each group consisted of approximately 6-10 workers and was facilitated by the primary researcher. Participants from both the WI and WEI interventions were mingled in each group meeting. Participants were asked to let the researcher

know if any supervisors and supervisees were in the same group meeting so that one of them could be reassigned. This was intended to reduce any discomfort around disclosing personal information in front of an employer/employee. However, no such changes were necessary. Meetings were audio tape recorded, and a random sample of the recordings from various workshops was reviewed by an independent individual who was blind to the hypotheses of the study. This review was conducted for a validity check of the workshop interventions using a standard rating form (Appendix 4) to ensure that workshop meetings were reasonably standardized and addressed the appropriate material across groups.

The first workshop meeting consisted of education about stress, the workstyle concept and its relationship to WRUEDs, introduction to the workstyle model, and initial identification of each participant's workstyle profile (Sample Workstyle Profiles - Appendix 7). Workers received information about their specific workstyle profiles as based on their responses to the workstyle survey that was developed by Feuerstein et al. (2003) and education about how to address/modify potential high-risk behaviors, cognitions, and physiological responses. The feedback was based on the particular workstyle measure subscales that were indicated as risk factors for that person based on "high risk" cutoffs (any score that is one standard deviation above the mean subscale score of the original sample in the initial validation of the workstyle measure). For specific workstyle-related subscales and interventions matching each subscale, see Appendix 6. After the educational portion of the meeting, group members engaged in a facilitated discussion regarding their understanding of workstyle. The meeting ended with a homework assignment and a preview of the topics to be covered in meeting 2. Assigned homework included gathering stress and workstyle self-observations on a "response log/checklist" (Appendix 7)

The second workstyle group meeting occurred 1 week later and consisted of a review of the past meeting and homework, followed by education and discussions of forceful motion and rest breaks at work. Lastly, participants received review of relaxation techniques including progressive muscle relaxation and diaphragmic breathing. Following this educational portion of the meeting, group members engaged in a facilitated discussion to intervene on issues of forceful keying and other working behavior (e.g., poor work postures, excessive reaches, etc.) and the importance of self-care and rest. Interventions were based on a cognitive-behavioral model of change in attitude and behavior (Barlow, 2001). A portion of the second meeting focused on problem-solving strategies (D'Zurilla, 1990) for the group regarding the topics under discussion. Assigned homework after this meeting included monitoring individual responses (e.g., not taking breaks and working with forceful motions), the triggers for these high-risk responses, and what factors kept these behaviors active in their daily routines. Information about these factors was gathered via the workstyle profile form (Appendix 7). Participants were encouraged to practice the relaxation techniques learned in this meeting both during free time (at work or home) and/or during recognized periods of stress and workstyle responding. This practice was intended to enable the workers to use relaxation as an active coping response to periods of stress and/or adverse workstyle responses (as identified by pain, symptoms, and self-monitored thoughts/behaviors).

The third workstyle intervention meeting occurred 1 week after the second workshop and began with a review of the previous meeting and the workstyle homework (Appendix 7) to discuss what did and did not work to reduce adverse workstyle responses. Participants engaged in a facilitated discussion regarding the topics of perfectionism and fear of making mistakes and generated alternative responses to these cognitions or behaviors. This discussion was followed

by a facilitated discussion and problem-solving session regarding effective communication skills and help-seeking behaviors. The final portion of the meeting consisted of discussions regarding how the workers could continue to use the information they had learned in the group. For homework, participants were asked to attempt these alternative responses as part of their continuing effort to modify workstyle and to monitor the effectiveness of these responses. Participants were also encouraged to continue practicing their relaxation techniques.

Within a week after the first and second workstyle meetings, participants in the Workstyle Intervention group received emails with a summary of the lesson for that week and encouragement to practice the skills they learned in group. After the third workstyle meeting, participants received emails with a summary of the treatment program, encouragement to continue practicing the exercises/alternative behaviors learned in group, and instructions to complete the post-test survey on the website. Participants received a reminder email at 3 months after treatment completion to complete the follow-up survey on the website (Appendix 5). This process resulted in a total of seven contacts (3 personal; 4 via email).

Workstyle and Ergonomic Intervention (WEI)

The members of the WEI group received the same ergonomic intervention as the EI group (baseline ergonomic consults/visits, and follow-up as needed) and the same workstyle intervention as the WI group (three workstyle workshops) for a total of 5 personal contacts. The participants in the WEI group did not receive any email contacts other than an email with a summary of the lessons learned in group at the completion of the study, and emails with the same summary of lessons combined with instructions to complete the post-test and 3-month follow-up surveys via the website (Appendix 5) for a total of eight contacts (5 personal; 3 email).

Wait-List Control (WLC)

The WLC group was used to assess the effects and changes over time that may occur independently of any interventions. Participants in the WLC group did not receive any ergonomic or workstyle modification, nor did they receive any email contacts other than the emails requesting completion of the baseline, post-test, and 3-month follow-up surveys via the website (Appendix 5). This process resulted in a total of three contacts (3 via email).

The participants in this group were full-time office workers who were asked to continue working as they would ordinarily do. These participants were not exposed to any increased risk as a result of participating in this study and were only asked to report symptoms at baseline, post-test, and at the 3-month follow-up period. Additionally, participants in the group (and in the other three intervention groups) were not prohibited from engaging in usual access to care (i.e., physician or physical therapy visits, etc.); and data regarding access to care was collected (for participants in all four intervention groups) and examined in subsequent analyses. Participants in the wait-list control intervention will receive either the most efficacious intervention or the intervention they prefer if no differences are found among the groups at the conclusion of the study. However, controls will not receive any follow-up visits.

Treatment Integrity

To ensure that the ergonomic consultations and workstyle group meetings adhered to the planned protocol and were administered similarly, all ergonomic visits and workstyle meetings were audiotape recorded and reviewed by an independent individual who was blind to the hypotheses of the study. The reviewer evaluated a random sample of the ergonomic and workstyle meeting tapes using a standard rating form (Appendix 4). The rater was required to

score whether key protocol topics addressed using a seven-point Likert scale ranging from covered “not at all” to “extensively.”

The relevant questions for each visit type were added together to create an ergonomic validity score and a workstyle validity score. A cut-off score of 24 for ergonomic visits and 120 for workstyle meetings was assigned to assess adherence to the treatment protocol. These cutoff scores were computed by assuming a rating of 4, the midpoint of the rating scale, for all of the items relevant to each particular visit. One sample t-tests were conducted to ensure that the scores for the visits were not significantly lower than these cutoff values. Also, any critical items with a median score less than 3, corresponding to covered “some” were examined and reported. These examinations were conducted to ensure adherence to the protocol and to ensure there was no bias from the primary researcher, who facilitated all ergonomic and workstyle meetings and who was aware of the hypotheses of the study.

Measures

(See Table 4 for a list of all measures, the number of items in each measure, and the estimated time required for survey completion. <u>See Appendix 11 for the complete Workstyle Study Survey with all items</u>).

Insert *Table 4* about here

<u>Screening Measures</u>

Depression

The Beck Depression Inventory-Second Edition (BDI-II; Beck, Steer, & Brown,1996) was included to screen participants regarding mood symptoms. This survey has been validated with primary care patients and demonstrated an internal consistency of α=0.94, correlated with other measures of mental functioning, and was shown to discriminate between depressed and

non-depressed patients (Arnau, Meagher, Norris, & Bramson, 2001). Individuals with a "moderate" score of 20 or higher, or who indicated suicidal ideation on BDI-II item 9, were excluded from the study to reduce possible confounding between mood and symptoms.

Anxiety

The Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988) was used to screen participants regarding anxiety symptoms. This inventory demonstrates an internal consistency of α=0,92, a test-retest reliability of r=0.75, and was shown to correlate with other anxiety measures and was able to discriminate between anxious diagnostic groups and non-anxious individuals (Beck, et al., 1988). Individuals with a "moderate" score of 16 or higher were excluded from the study to reduce confounding between mood and symptoms.

Sociodemographic Information

Participants provided information regarding age, gender, race/ethnic background, handedness, education level, marital status, and number of children living in the household. Participants reported the number of years they have been at their current job and the average number of hours they work per week. Participants were also asked to list current treatments that they used to manage their upper extremity symptoms, including healthcare visits, prescribed medications, and over-the-counter medications using standardized questions (Feuerstein et al, 2000). Finally, participants completed a visual analogue scale rating how effective they expected their study intervention condition would be for reducing their upper extremity symptoms.

<u>Process Measures</u>

Workstyle

Workstyle was assessed using the Workstyle Survey (Feuerstein et al., 2004). This survey consists of 91 total items and demonstrated good internal consistency (α=0.91), test-retest reliability (*r*=0.89) and is correlated with measures of pain, symptoms, and functional limitation. The measure was also independently associated with the presence of WRUE symptoms (*OR*=2.51; 95% *CI*=1.18 – 5.38) in a logistic regression model accounting for ergonomic and job stress factors.

Ergonomic

Ergonomic exposures were self-reported by all participants using the Job Skills and Physical Demands Survey (JRPD; Marcotte et al., 1997) via the reduced, 24-item JRPD-UE questionnaire identified by Dane and colleagues (JRPD-24; 2002). The JRPD-24 yielded an internal consistency α=0.82, was significantly correlated with WRUE outcomes, was able to discriminate among levels of WRUE outcomes, and accounted from 7%-27% of the variance in clinical outcomes in the Dane et al. (2002) study.

Job Stress

Job stress was assessed via nine questions from the NIOSH Work Questionnaire regarding workload, workload variability, and workload exhaustion (Hales et al., 1994). These items have been shown via path analyses to be related to the workstyle model and are predictive of clinical outcomes at 12 months post-baseline (Nicholas et al., 2004).

Treatment Efficacy

Participants reported their perceived treatment efficacy by responding to one question asking, “How effective do you think your intervention group will be for reducing your upper

extremity symptoms?" This question was scored via a five-point Likert scale with answers ranging from "not at all" to "extremely." This item was examined at baseline only to ensure that no differences existed among the EI, WI, and WEI groups. It was expected that there would be a significant difference among these three groups and the WLC group because participants knew that the WLC group would not receive any active intervention.

Outcome Measures

Symptoms

Respondents reported their level of pain within the past week by using an 11-point visual analogue scale of pain (VAS Pain; Huskisson, 1974), ranging from zero to ten (no pain to severe pain, respectively), which has been shown to be sensitive to changes in subjective pain (Feuerstein et al., 2000a). Respondents also reported symptoms via the NIOSH Symptom Survey regarding the frequency, duration, and intensity of symptoms. This survey has been shown to be sensitive to changes in symptom status (e.g., Bernard et al., 1994).

Upper Extremity Symptom Interference with Function

The Upper Extremity Function Scale (UEFS) was included to measure the degree to which respondents believe their symptoms affect their overall functioning in daily activities (Pransky et al., 1997). This survey was shown to have high internal consistency (α=0.83 – 0.93), discriminated among levels of severity in affected workers, and was significantly correlated with measures of pain and objective physical examinations (Pransky et al., 1997).

General Physical and Mental Health

The Short Form 12 (SF-12) Health Survey Version 2 (Ware, Kosinski, & Keller, 1998) was included as a generic self-report measure of the participants' perceived overall physical and mental health. This measure produces a physical health summary score (PCS) with a test-retest

reliability of *r*=0.89 and a mental health summary score (MCS) with a test-retest reliability of *r*=0.76. Both summary measures were able to discriminate between "known groups" of participants with certain diseases/disorders, resulting in relative validity coefficients of 0.43-0.78 for the physical health summary score and 0.93-0.98 for the mental health summary score (Ware, Kosinski, & Keller, 1998).

Workplace Productivity

Workplace productivity was measured via the Stanford Presenteeism Scale-Short Form (SPS-6) that measures perceived productivity (Koopman et al., 2002). This measure has high internal consistency (α=0.80), significantly correlated with other measures of productivity, and was correlated negatively with disability in a validation study (Koopman et al., 2002).

Data Analyses

<u>Overview</u>

All statistical analyses were conducted using the Statistical Package for the Social Sciences (SPSS) version 11.5 (SPSS, 2003). Examinations of workstyle scores, ergonomic and work stress process measures, and clinical outcome measures (i.e., pain, symptoms, functional limitation, health, and productivity) were conducted via 4 X 3 repeated measures analyses of variance (ANOVAs), examining each measure by the four treatment groups at the three time points of baseline, post-test, and 3 months. Post hoc tests were conducted as necessary on significant main effects and interactions to further define effects. The main analyses are described below.

<u>Test of Process Hypotheses</u>

Analysis 1: Examination of the effect of intervention group on Workstyle scores

To examine the effect of intervention conditions on workstyle scores across time, a 4 X 3 ([4 Groups= EI, WI, WEI, WLC] X [3 Times= baseline, post-test, 3 Months]) repeated-measures ANOVA was conducted to determine if any differences existed among the four groups over the three assessment periods. Post hoc tests followed to examine significant main effects or interactions.

Analysis 2: Examination of the effect of intervention group on job stress and ergonomic scores

To determine the effect of intervention conditions on job stress and ergonomic risk exposure scores across time, 4 X 3 ([4 Groups= EI, WI, WEI, WLC] X [3 Times= baseline, post-test, 3 Months]) repeated-measures ANOVA examined group differences on the NIOSH work stress survey and the JRPD over the three assessment periods. Post hoc tests followed as applicable.

Test of Outcome Hypotheses

Analysis 3: Examination of the effect of intervention group on pain, symptoms, functional limitation, physical/mental health, and productivity

Repeated-measures 4 X 3 ([4 Groups= EI, WI, WEI, WLC] X [3 Times= baseline, post-test, 3 Months]) ANOVAs were used to individually examine the group effects and/or interactions across time on 1) functional limitation (UEFS), 2) general physical health (SF-12 PCS), 3) general mental health (SF-12 MCS), and 4) workplace productivity (SPS-6). Post hoc tests were conducted to further delineate any significant main effects or interaction effects.

Drop-outs

Participants who dropped-out of the study at any time after completion of the first online survey were included in an “intention to treat” analysis where their most recent data was carried

forward to all subsequent assessment periods and examined by all repeated measures analyses used in determining the change in outcome and process measures by group over time. Data from these individuals was also examined to determine if there were any differences between those who did not complete the study and those who did complete.

RESULTS

Participants

A total of 80 individuals completed informed consent forms and were screened. Of these, 61 individuals met inclusion criteria to participate in the study. Participants were then randomly assigned to one of the four intervention conditions and completed the baseline survey. Sociodemographic and work characteristics of included participants are presented in *Table 5*. The remaining 19 individuals were excluded for the following reasons: 14 individuals did not meet inclusion criteria (e.g., had been diagnosed with diabetes, had broken their arm, etc.) and 5 failed to complete the baseline survey.

Insert *Table 5* about here

Dropouts

During the acute intervention phase, 7 individuals (1 EI, 3, WI, 3 WEI, and 0 WLC) dropped out (11%), all stating that they did not have enough time to participate in the study. After the intervention phase, 12 participants (20%) did not complete follow-up surveys (3 EI, 2 WI, 2 WEI, and 5 WLC). In total, 42 participants (11 EI, 11 WI, 11 WEI, and 9 WLC) completed all phases of the study and all surveys.

Comparisons were run to determine if individuals who dropped out of the study at any time differed from those who completed the study (*Table 6*). Individuals who dropped out did

not significantly differ from completers on any sociodemographic or process measure. However, there was one difference found in outcome measures between completers and noncompleters. Individuals who dropped out during the study procedures had significantly higher (more positive) perceived mental health scores (SF-12 MCS; M=56.1, SD=5.2) than individuals who completed the study (M=47.1, SD=9.2), $F(2, 57)$ =4.1, p<0.05). Neither group was significantly different from individuals who dropped out at follow-up (M=49.3, SD=4.4).

Insert *Table 6* about here

Treatment Integrity

An examination of the audio recordings of four randomly selected workstyle group meetings and four randomly selected ergonomic visits indicated that the facilitator adhered to the treatment protocol ergonomic visits with both EI and WEI members (M=31, SD=1.2) and across workstyle modification group meetings containing WI & WEI members commingled in each group (M=144.5, SD=10.1 and. The one sample t-tests revealed that the validity scores were significantly higher than the cutoff scores of 24 for the ergonomic visits, $t(3)$=12.1, p<0.01), and 120 for the workstyle meetings, $t(3)$=4.9, p<0.05. Examination of each item suggested that all topics were adequately covered for the workstyle groups (*Table 7*). All topics for the ergonomic visits were appropriately covered with the exception of rest breaks, where the median score for the item asking, “Did the evaluator provide rationale for rest breaks and encourage the worker to increase the number of breaks s/he takes throughout the workday?” was 2, a score between “not at all” and “some.” The ergonomic visits included encouragements to increase the number of rest breaks but did not provide an explanation of the rationale for taking breaks in relation to the concept of workstyle.

Insert *Table 7* about here

Treatment Effects on Process Measures

Workstyle

A 4 X 3 ([4 Groups= EI, WI, WEI, WLC] X [3 Times= baseline, post-test, 3 Months]) repeated measures ANOVA was conducted to determine if there were any significant treatment effects for workstyle (*Table 8*). The repeated measures ANOVA for workstyle revealed a significant effect of time, $F(2, 76) = 16.0$, $p<0.01$, $\eta_p^2 = 0.30$), but no significant effect of group or a group by time interaction (*Figure 5*).

Insert *Figure 5* about here

Post hoc tests (LSD; Table 9) revealed that workstyle scores significantly decreased, $p<0.05$, from baseline (M=145.8, SD=36.8) to post-test (M=139.1, SD=34.1) and significantly decreased ($p<0.05$) from post-test to 3 months (M=127.1, SD=32.0).

Insert *Tables 8 and 9* about here

Self-reported Ergonomic Exposures

The repeated measures ANOVA for self-reported ergonomic exposures using the JRPD revealed a significant effect of time, $F(2, 76) = 15.4$, $p<0.01$, $\eta_p^2 = 0.29$), but no significant effects of group or group by time interaction (*Figure 6*).

Insert *Figure 6* about here

Post hoc tests (LSD) showed that participants reported significantly fewer ($p<0.05$) ergonomic exposures at post-test (M=51.6, SD=11.5) than at baseline (M=55.7, SD=10.5) and that exposure at 3 months (M=49.2, SD=10.3) was lower than at baseline, $p<0.05$. There was no difference in ergonomic exposures between the post-test and 3 month time periods.

Work Stress

The repeated measures ANOVA for NIOSH work stress revealed no significant main effects for group or time or group by time interaction (*Figure 7*).

Insert *Figure 7* about here

Treatment Effects on Outcome Measures

<u>Pain</u>

A 4 X 3 ([4 Groups= EI, WI, WEI, WLC] X [3 Times= baseline, post-test, 3 Months]) repeated measures ANOVA was conducted to determine if there were any significant treatment effects on VAS ratings of pain (*Table 8*). This analysis revealed a significant time effect, $F(2, 76) = 7.4$; $p<0.01$, $\eta_p^2 = 0.16$), but no significant group effect or group by time interaction (*Figure 8*).

Insert *Figure 8* about here

Post hoc tests (*Table 9*) using least significant difference (LSD) examinations of significant differences among the three time points (baseline, post-test, 3 months) across groups revealed that VAS scores at 3 months (*M*=4.5, *SD*=2.3) were significantly lower, $p<0.05$, than scores at baseline (*M*=5.9, *SD*=2.3) and at post-test (*M*=5.4, *SD*=2.8). Baseline and post-test scores were not significantly different.

<u>Composite Symptoms</u>

The 4 X 3 ([4 Groups= EI, WI, WEI, WLC] X [3 Times= baseline, post-test, 3 Months]) repeated measures examination revealed a significant effect of time, $F(2, 76) = 4.5$, $p<0.05$, $\eta_p^2 = 0.11$), but no significant effect of group or group by time interaction (*Figure 9*). Post hoc tests (LSD) revealed that across all groups, scores at 3 months (*M*=69.1, *SD*=72.6) were significantly

lower, $p<0.05$, than scores at baseline (*M*=106.0, *SD*=101.7). There were no differences between baseline and post-test (*M*=98.0, *SD*=108.6) or between post-test and 3 months.

Insert *Figure 9* about here

Functional Limitations

The 4 X 3 ([4 Groups= EI, WI, WEI, WLC] X [3 Times= baseline, post-test, 3 Months]) repeated measures examination revealed no significant effects of group, time, or group by time interaction (*Figure 10*).

Insert *Figure 10* about here

General Physical and Mental Health

Repeated measures examinations of the SF-12 physical and mental health subscales showed no significant effects of group, time, or group by time interaction on perceived physical health (*Figure 11*). For perceived general mental health, there were also no significant effects of group, time, or group by time interaction (*Figure 12*).

Insert *Figures 11* and *12* about here

Self-reported Productivity

The repeated measures ANOVA for self-reported productivity showed no significant effects of group, time, or group by time interaction (*Figure 13*).

Insert *Figure13* about here

Intention to Treat Examinations

Intention to treat examinations of outcome variables using each participant's most recent data revealed the following effects:

1) A significant time effect for pain, $F(2, 100) = 9.3$, $p<0.01$, $\eta_p^2 = 0.16$, with LSD post hocs revealing that pain scores were significantly lower, $p<0.05$, at post-test (M=5.2, SD=2.7) compared to baseline (M=5.8, SD=2.4) and that scores were significantly lower at 3 months (M=4.6, SD=2.3) compared to both baseline and post-test, $p<0.05$.
2) A significant time effect for symptoms, $F(2, 80) = 3.2$, $p<0.05$, $\eta_p^2 = 0.08$, with LSD post hocs showing that symptoms were significantly higher, $p<0.05$, at baseline (M=119.6, SD=103.8) than at post-test (M=109.0, SD=111.7) and 3 months (M=91.5, SD=92.2); and that symptoms scores did not significantly differ between post-test and 3 months.
3) A significant time effect for workstyle, $F(2, 98) = 12.6$; $p<0.01$, $\eta_p^2 = 0.20$, with LSD post hoc examinations revealing that workstyle scores significantly decreased, $p<0.05$, from baseline (M=140.2, SD=32.9) to post-test (M=135.0, SD=32.9) and that a significant decrease, $p<0.05$, was also found from post-test to 3 months (M=127.6, SD=30.9).
4) A significant time effect for ergonomic exposure, $F(2, 114) = 16.6$, $p<0.01$, $\eta_p^2 = 0.23$, and LSD post hoc tests showing that exposure to ergonomic risks was significantly higher, $p<0.05$, at baseline (M=56.1, SD=9.9) than at post-test (M=52.6, SD=11.1) or at 3 months (M=51.0, SD=10.6) and that ergonomic exposures did not significantly differ between post-test and 3 months.

Additional Analyses

Intercorrelations Among Process and Outcome Measures at Baseline

In order to examine the relationships among workstyle, ergonomic exposures, stress, productivity, and pain, bivariate correlations were calculated (Table 10). These relationships were explored to further the understanding of how these factors relate to one another prior to any intervention. This examination revealed significant correlations between workstyle and job

stress, $r = .66$, $p<0.01$, and between workstyle and pain, $r = .54$, $p<0.01$. Job stress, $r = .49$, $p<0.01$, and symptoms, $r= .48$, $p<0.01$, were also significantly correlated with pain; and job stress and symptoms were significantly correlated with each other, $r = .33$, $p<0.05$. The measure of ergonomic exposure was not related to stress, pain, or symptoms. Ergonomic exposure was found to be negatively correlated with productivity, $r = -.41$, $p<0.01$. No other significant relationships were observed for ergonomic exposure.

Insert *Table 10* about here

<u>Intercorrelations Among the Change in Process and Outcome Measures Over Time</u>

To examine the relationships among the changes over time for workstyle, ergonomic exposures, stress, productivity, and pain, change scores from baseline to 3 months were calculated. The relationships among the change scores were examined using bivariate correlations (*Table 11*). This examination revealed significant correlations between the change in workstyle and the change in pain, $r = .38$, $p<0.05$, change in symptoms, $r = .36$, $p<0.05$, and change in job stress, $r = .43$, $p<0.01$. The change in pain was also significantly correlated with the change in symptoms, $r = .32$, $p<0.05$.

Insert *Table 11* about here

<u>Depression and Anxiety Scores</u>

The BDI and BAI scores for participants at screening were examined to determine if any significant differences existed among the four groups at screening. A one-way ANOVA found no significant differences among the groups on either measure (see *Table 8*). The scores for both measures fell within the "minimal" to "mild" range for all participants with the average scores for both measures in the minimal range (BDI: M=4.1, SD=4.8; BAI: M=4.8, SD=3.5).

<u>Power Analyses</u>

A power analysis was conducted to examine the overall statistical ability to detect treatment effects, given the sample size in the present study. This analysis demonstrated that this study had only 46% power for main effects of group, 43% for main effects of time, and 16% for interaction effects (Table 12). To improve the overall power in future studies, a power calculation using the values found in the present study determined that 23 participants per group (92 total participants) would be needed to achieve 80% power.

DISCUSSION

The present study indicated that on primary measures of outcome (pain and general symptoms), the three intervention groups and the wait-list control group all improved over time. Improvements over time were also found for ergonomic exposure and workstyle measures in all groups, including the wait-list control group. These improvements over time for these outcome and process measures are likely due to nonspecific effects.. These factors may include Hawthorne/attention effects, natural history effects (i.e., regression to the mean) and the episodic nature of upper extremity symptoms and disorders. It also appears that the interventions provided in the current study were not sufficient to produce a significant improvement over non-treatment.

The Hawthorne effect can be described as a beneficial effect of attention on participants in research, regardless of the specific nature of the intervention received (Bouchet, Guillemin, & Briancon, 1996; Holden, 2001). The Hawthorne effect is different than the placebo effect, which can be defined as a change in illness attributed to the symbolic import of a treatment rather than the mechanism of treatment itself (Turner, Deyo, Loesser, Von Korff, & Fordyce, 1994). In the case of the present study, the fact that the waitlist control group improved over time, despite

receiving no intervention, and that this improvement was not significantly different from changes observed in the intervention groups suggests that the Hawthorne effect was in operation. An example of how the Hawthorne effect may influence the outcomes in studies is demonstrated by Bouchet and colleagues (1996), who found that the simple act of completing two questionnaires in a quality of life outcome study produced an effect that persisted even after statistically correcting for other nonspecific effects, such as regression to the mean, etc. A similar effect may have occurred in the present study where the waitlist control group members did complete three surveys. This survey completion (and perhaps the awareness gained from this process) may have been sufficient to produce subsequent change.

The natural history effect refers to changes that occur in a measure over time, such as regression to the mean, spontaneous clinical evolution of the variable under study, or other time-related changes that are characteristic of longitudinal studies (Bouchet et al., 1996). Any of these natural history effects may have been operative in the present study. One likely natural history effect in the present study is regression to the mean, which can be described as a change over time in outcome that moves away from an extreme value and toward the mean value of the variable under study. This change is often seen when participants are selected for inclusion because of their extreme position on that variable (Minium, King, & Bear, 1993). In the case of the present study, participants were selected (or self-selected) as volunteers because they were experiencing pain and other symptoms at the time of recruitment rather than being randomly recruited from the general workplace. Therefore, it is statistically likely that their pain and symptom ratings would regress toward the overall workplace mean of lower symptoms and pain over time. Recruiting volunteers, rather than random recruitment from the population may increase the possibility of regression to the mean because these volunteers may have been

experiencing higher symptoms than others in the workplace (nonvolunteers), and this nonspecific effect may have played a role in the outcomes of the present study.

Related to the natural history effect is the episodic nature of WRUESs (Terrono & Millender, 1996). Often, upper extremity symptoms of pain, numbness and tingling remit and then reoccur, waxing and waning in severity over time, especially in the early stages of WRUE problems. These problems often do not generate constant pain and/or other symptoms until in the chronic stage of the disorder. This is a common feature of these work-related disorders (Terrono & Millender, 1996). For the present study, as with regression to the mean, individuals who agreed to participate in the study were currently experiencing moderate to high levels of symptoms at the beginning of the study (e.g., the mean pain score at baseline was 5.8 out of 10). Therefore, it is possible that these symptoms decreased over time from the higher initial levels and/or that the post-test and 3 month surveys were completed during a waning phase of the symptoms. At this assessment, 69% of all participants showed improvement over baseline symptoms. However, if the episodic nature of the symptoms is responsible for the improvement, it is likely that over time, all groups may return to baseline levels of pain and symptoms at some point. This trending could be investigated more fully in longer-term follow-up assessments, but was not able to be examined in the present study because of the relatively short follow-up.

Perhaps the most important possibility to consider when interpreting the results of the present study is that the interventions under study did not produce a strong enough magnitude of effect. The active treatments may not have been sufficiently concentrated, comprehensive, or long enough, or the interventions may not have been delivered in an optimal format (i.e. groups vs. internet or some other format) for this very busy workforce to result in clinically meaningful results. The interventions provided in the current study, both ergonomic and workstyle, were

largely focused on education and generating minor modifications at the workplace. The interventions were brief and did not introduce new equipment or organizational changes. Additionally, the researchers were unable to provide a significant amount of individualized attention to each participant, especially in areas related to cognitive and behavioral changes. For example, participants in the ergonomic and workstyle modifications were directed to take breaks at work, pace their work, maintain healthy postures that avoid non-neutral positions, and to avoid forceful movements. The researchers did not link these behaviors to any reinforcers (e.g., prizes, praise, etc.) other than presenting evidence that engaging in behaviors would reduce risk for more severe problems. Also, monitoring each participant for compliance with these behavior changes was not conducted in this study because of timing constraints for both participants and researchers. However, ongoing monitoring of compliance might also have helped to assist workers to engage in these behaviors.

Previous research indicates that these work-related symptoms are, in fact, difficult to modify, especially in the subacute stages. Some studies employing ergonomic interventions similar to those used in the present study have yielded equivalent results. A recent review of interventions to reduce work-related musculoskeletal disorders found mixed results for interventions in computer users (Silverstein & Clark, 2004). Few studies in this review showed any significant improvements in pain or symptom outcomes after the intervention and fewer still showed any effect that lasted beyond short-term effects. One of these studies (Mekhora, Liston, Nanthavanij, & Cole, 2000) was very similar to the current study's ergonomics intervention component involving minor workstation adjustments without the provision of new equipment, such as keyboards, mouse input devices, etc. That study found similar results as those in the present study: some changes in discomfort over time and no significant differences between the

intervention group and a delayed treatment group (Mekhora et al., 2000). King's (1995) review of lecture-based ergonomic education training also indicated that short-term lecture-based training alone was insufficient to produce lasting change. These results were similar to those found in the present study, although the present study used an interactive psychoeducational approach instead of lecture format.

Interestingly, the present study showed that although ergonomic exposures may be associated with decreased productivity, there were no correlations between ergonomic exposure, pain, or symptoms. This finding is contradictory to other studies that have found a relationship between ergonomic factors and pain or symptoms (i.e., Marcus et al., 2002; Nicholas et al., 2004; Warren et al., 2000). There were significant correlations among job stress, workstyle, pain, and symptoms, suggesting that for these participants, job stress and workstyle influenced the experience of pain and symptoms. This relationship provides support for the position that workstyle is associated with cognitive, behavioral, and physiological responses to stress that can exacerbate symptoms, as suggested by the workstyle model (Feuerstein, 1996; Feuerstein et al., 1999; Haufler et al., 2000).

Job stress and associated workstyle can affect the physiological changes that impact pain and stress (Melzack, 1999). For example, prolonged activation of stress regulation can cause a cascade of changes in the nervous system (i.e., the release of catecholamines and immune system changes) that can exacerbate upper extremity symptoms (Barr & Barbe, 2002; Melzack, 1999). In such a case, a maladaptive cognitive and behavioral workstyle responses can maintain the experience of stress from workplace factors and may even contribute to self-imposed stress. Although the mechanisms behind the relationships found in the present study among stress, workstyle, and WRUES are not clear, these results provide further evidence for the need for

multicomponent interventions to produce lasting improvements in WRUESs. The relationship of workstyle with both job stress and pain/symptoms suggests that traditional biomechanical intervention efforts may benefit from targeting workstyle behavior and attitude changes in some form.

The workstyle intervention approach used in the present study was a cognitive-behaviorally focused approach. While there are few studies examining cognitive-behavioral interventions for upper extremity symptoms in the workplace, investigations with chronic upper extremity cases suggest that the workstyle intervention techniques provided in the current study may not have been sufficient to produce differential improvements in pain and symptoms. It was originally assumed that providing education, increasing awareness of participants' patterns of workstyle, and offering suggestions for changing some of the workstyle risk factors would be sufficient for certain behavioral and cognitive change. Spence (1998) reviewed studies that used cognitive-behavioral therapy in the management of chronic upper extremity problems. This review showed that CBT techniques were helpful for rehabilitation of chronic upper extremity symptoms/disorders; but for early intervention and prevention in a working population, the data were inconclusive. It appears that a different approach may be required for workers with early-stage or episodic symptoms. Faucett and colleagues (2004) conducted a workplace study that included a cognitive-behavioral intervention in six small group education sessions, each lasting 1 hour, with similar content to the present study. However, these authors found only a modest decrease in symptoms at the end of the 6-week treatment, which did not persist at the 32-week follow-up. These authors also found no significant difference between the cognitive-behavioral psychoeducation group and the wait-list control group at follow-up. These studies and the current study suggest that cognitive-behavioral treatment techniques may be useful; however, it

is possible that because of the differences in symptom presentation and motivation in participants with early, episodic, symptoms vs. chronic cases require a novel approach for educating participants about WRUEDs.

The results of the present study and of other early secondary prevention studies in this area, such as those mentioned above, demonstrate how difficult it is to produce preventive cognitive and behavioral changes that translate to improvements in symptoms in the workplace context. Many well-designed studies conducted in the workplace have had difficulty generating meaningful behavioral changes (i.e., King, 1995; Emmons et al., 1999). It is also important to recall that all participants in the present study scored in the “high” workstyle range which has been associated with WRUE problems (Nicholas et al., 2004), and because of this high level of workstyle, this complex cognitive, behavioral, and biomechanical response pattern may be more resistant to simple interventions. Although considering workstyle in an intervention program is likely to be useful (Nicholas et al., 2004), the optimal approach has not been generated as yet.

Future studies would also benefit from an increased sample size. The power analyses show that the present study was greatly underpowered. This lack of statistical power limits the ability to find a treatment effect if one exists. An extrapolation of the current results showed that future studies would need to have a minimum of 23 participants per group. Although the present study may have needed more comprehensive interventions for lasting changes in outcomes, a larger sample size may have provided enough power to detect group differences. These differences may have highlighted the approach that was truly most effective in this study. This information could then have been used identify the most successful intervention in this study and build upon it for a more comprehensive approach. However, without the ability to differentiate among groups, this process is limited. Therefore, future studies should ensure that they meet the

minimum sample size recruitment to ensure that more information can be available from the study results.

The combination of increasing the duration or comprehensiveness of the program along with increasing the number of participants may prove difficult because of the realistic constraints of the workplace and the difference in motivation between participants engaged in an early secondary prevention intervention at work as opposed to chronic pain patients at a treatment facility. Initial recruitment for participants at the workplace used in this study was difficult because many participants did not want to commit to the time requirements of the study. This study's group meetings were conducted once a week during the workers' lunch breaks. The meetings were intended to last 90 minutes and the workers were asked to clear this time from their schedules, but many participants arrived at the meetings asking to leave after 60 minutes. Group discussions also appeared to diminish after 60 minutes, so most meetings did not persist beyond 60 minutes unless the educational material for that meeting was not yet complete. These difficulties in the present study demonstrate that workplace constraints may require different and creative approaches to enable participation, such as telehealth formats (i.e., web-based video meetings) and other such innovative methods directed at changing attitudes and behaviors relating to workstyle over the long-term so that improvements in symptoms can occur.

In addition to the difficulty recruiting and retaining participants in an intensive, longer-duration preventive multicomponent program, it is a challenge to produce lasting behavioral changes in the workplace context because of the often competing reinforcers that are present in this environment (O'Donohue, 1998). The present study encountered some experiences that highlight the difficulty of producing behavioral changes in workers. For example, many of the workers in the workstyle meetings were interested in the content of the meetings and were

specifically interested in seeing their personalized workstyle risk factor profiles. Most reported that it was helpful to see a graph of their personal, risky behaviors, and how these related to the “average worker” according to standardized cut-off scores. However, most stated that they were not surprised to learn that their responses were higher than average. In other words, the participants said that they knew they worked too long, too forcefully, without rest, and with excessively high standards for themselves, but most were unwilling to change and/or thought that these risky responses were necessary at the workplace. Some participants said that they liked working in this way and many said that they felt that such thoughts and behaviors were helpful for getting things done in their work context. They believed that the workplace often reinforces the worker who will take on extra projects and work long hours. This belief is often supported when one considers that workers who behave in such a way are often given “employee of the month” awards, good performance reports, etc., that are not only externally reinforcing, but also personally rewarding. This reinforcement pattern represents a variable reinforcement schedule that learning theory promotes as strongly maintaining behavior (O’Donohue, 1998). Therefore, despite being associated with pain and functional limitation, workstyle is highly rewarded in the workplace and its modification will likely require a multifaceted approach that is guided by the evidence in this area, but also demonstrates that workers will still be able to meet their workplace goals after incorporating the recommended changes. The present study provided initial evidence that productivity should not be adversely affected by reducing risky workstyles by showing that the unhealthy workstyle responses were not correlated with productivity but were correlated with poorer health. This data may be useful in future studies to show workers that reducing adverse workstyle responses can reduce their WRUES/D risks without negatively impacting their workplace goals.

This attention to the participants' workplace goals is an important factor to consider. To be successful, intervention programs may have to contend with the difficulty of motivating symptomatic but functional individuals to adopt and maintain new behaviors, such as rest breaks, that promote WRUE health but may be contrary to the person's preferred working style. For example, in the workstyle sessions, most workers believed that increasing rest breaks would be helpful but believed that breaks would interfere with their productivity, despite being provided information to the contrary (i.e., Dababneh et al., 2001). Many of the workers believed that symptoms were inevitable and desired relief from symptoms, but few believed that they might actually develop disability related to upper extremity disorders. This belief system may help explain why the motivation and adherence to preventive programs may be less consistent than adherence to rehabilitative programs. The health belief model (Becker & Rosenstock, 1984; Sarafino, 2002) may provide a framework for understanding the potential difficulty in encouraging workers to make preventive behavioral changes and for providing some guidance about how to improve future interventions.

According to the health belief model, the likelihood that an individual will take preventive action, such as modifying an adverse workstyle, depends on the degree to which the individual feels threatened by the prospect of a health problem (i.e., WRUEDs) vs. their perceived pros and cons of making the changes. The perceived threat is influenced by their perceived likelihood of developing the problem, the perceived seriousness of the consequences of the problem, and the availability of cues that remind them about the health problem. Additionally, the person considers the benefits of making the changes against the barriers or costs that they think may prevent them from taking action. This model may provide useful information for the design of future early intervention efforts.

Future interventions for WRUES/Ds may benefit by addressing the components of the health belief model. For example, educational sessions may highlight the natural course of WRUEDs, explaining that symptoms tend to be episodic may wane or remit, as has likely been the case for these workers, but over time, may become chronic and debilitating (Terrono & Millender, 1996). This education was provided in the present study, but may have been more effective if greater time was spent in this area. Anecdotally, one of the groups in the present study had a participant who had carpal tunnel release surgery for symptoms in one hand and was symptom-free in the treated hand, but was developing symptoms in the other hand. This individual echoed and affirmed the educational information provided in the group, which may have increased the credibility of the information. Future interventions may capitalize on such peer influence, by encouraging those who have had symptoms and some functional loss in the past to describe their experiences to the group members (Yalom, 1995). Future intervention efforts may also employ simple visual aids, such as posters of the workstyle model or of graphs showing the progression of WRUE symptoms to disorders that can be hung in the workplace to serve as cues about the problem, such as the "cues to action" recommended by the health belief model.

Future studies must also address the perceived barriers or costs to behavioral change for preventive interventions. The workstyle meetings in the present study did address these by asking participants to think about and discuss these possible barriers with the group. Group members then used problem solving techniques to address these barriers. This exercise may have been helpful, but may not have been done frequently enough or with enough of the group members to produce change. Therefore, more time allocated to this process may be helpful.

The perceived barriers may also be addressed by involving direct supervisors and organizational leaders. McLellan and colleagues (2001) have conducted studies demonstrating that education and training for supervisors regarding how to respond to employees with musculoskeletal disorders produced favorable results that may translate to improved health outcomes for the injured worker (McLellan, Pransky, & Shaw, 2001; Pransky, Shaw, & McLellan, 2001). Similarly, Linton (1991) showed that a behavioral workshop for immediate supervisors improved behaviors for dealing with employees with neck and back injuries from both the researcher's perspective and the perspective of the supervisors' employees.

The present study did not include methods to improve supervisor and organizational leadership support for the program. Although the program was approved at the workplace, there were no official endorsements from senior management. Such a show of support may have helped participants feel more comfortable committing time to the interventions and reduced some of the perceived barriers to adopting cognitive and behavioral changes in their workstyles. This organizational support has assisted response to interventions at the workplace in the past, such as in the study by Feuerstein and colleagues (2000b) where supervisor participation in the planning and administering of a workplace intervention contributed to the effectiveness of a multidimensional program. Additionally, research suggesting that perceived supervisor support is likely to improve adherence and outcomes for preventive WRUES/D interventions (McLellan et al., 2001; Pransky et al., 2001; Linton, 1991) is further anecdotally supported by a case example from the present study.

The example involves one employee who experienced moderate pain symptoms and who was interested in participating in the Workstyle Intervention group, but was uncomfortable with

the time commitment involved. However, when she received support from her supervisor, she was able to benefit from the intervention. Major features of the case are described below:

> This participant informed the group that she usually skipped lunch to keep working, only taking breaks to visit the restroom. This worker stated that she felt unable to say no to extra work despite feeling pressured with her existing workload because she did not think her supervisor would understand the need to take care of her upper extremity symptoms and because she thought refusing to take on extra projects would adversely affect her performance ratings. However, this worker's supervisor was also experiencing WRUES and was participating in the Workstyle Intervention group that met on a different day. This supervisor was very interested in the program materials and wanted to share what she had learned with her workers. When the supervisor discussed what she learned in the workstyle groups with her workers, the employee who was participating in the groups disclosed that she, too, was participating in the study. The supervisor and the employee then had a discussion where the supervisor encouraged this employee to take rest breaks and to ask for help or extended deadlines when the employee felt overworked. Both women shared this experience with their respective groups and the facilitator. This discussion may have been very helpful to the employee in reducing her perceived barriers to workstyle modification. At the 3-month follow-up, this employee reported a 4-point reduction in VAS pain ratings, compared to the average decrease of 1.3 points across groups. The employee also provided the following comment: "Since the study, I do take breaks, have better sitting posture, exercise my hands prior to working, and have been able to say no when I have too much work."

Future studies may benefit by systematically obtaining supervisory and top organizational leaders to publicly and actively support and promote the intervention.

The feedback provided by the participants suggests that the workstyle concept and intervention are of interest to and potentially helpful for computer users with WRUESs. Future studies exploring this possibility should be conducted. Studies should also consider using a longer duration, more intensive modification program that addresses the limitations discussed above and includes possible improvements related to the health belief model to increase the

likelihood of preventive cognitive and behavioral change. The possibility of using different intervention approaches (i.e., individual vs. group formats) and/or the use of some other form of technology for administration (i.e., telehealth meetings or information) may also be of interest.

Another factor that should be considered for future workstyle efforts is a re-examination of the workstyle model itself. The workstyle model is primarily focused on the individual and how s/he responds to work demands, psychosocial stressors, and ergonomic exposures. These three influences are indirectly related to the organizational environment, but it is possible that an explicit organizational factor may need to be considered, especially in light of the observations discussed above. As this study and others (e.g., Linton, 1991, McLellan et al., 2001) continue to demonstrate the mediating effect of the organization, the workstyle model and other WRUED models may need to consider organizational factors, such as the safety climate and health climate of the workplace, and the roles that supervisors/leadership play in the risk factors for upper extremity health outcomes.

Limitations

There are certain methodological limitations of the current study other than those discussed above that should also be addressed in future research efforts. First, there was a difference in personal contacts among the treatment groups. The individuals in the WI and WEI groups received more personal contacts with the researcher than the EI or WLC groups. Although the use of email contacts was employed in an attempt to counteract the effect of attention among the three active condition groups by equalizing the total number of contacts (in any form), the differences in physical contact may play some role in generating differences among future groups, although no such effect was observed in the present study. Another related limitation is the absence of blinding procedures for both participants and facilitators in the

current design. In this study, the participants were aware of the intervention modality that they received and the other interventions that were offered as part of the study. Also, the individual providing the interventions was aware of the study's hypotheses. This lack of blinding may have led to bias and/or non-specific effects in the responses of the participants and in the actions of the intervention facilitator. Again, neither of these limitations appears to have overtly influenced the results of the present study because of the lack of group effects. However, these limitations should still be considered and remedied in future studies wherever possible.

Another possible limitation is the reliance on self-report measures. Some studies suggest that self-report measures are subject to bias and may be unreliable, especially for process measures, such as ergonomics (Spielholz, Silverstein, Morgan, Checkoway, & Kaufman, 2001). However, other studies have demonstrated that self-report measures are valid and applicable to detecting ergonomic risk (Dane et al., 2002; Silverstein, Stetson, Keyserling, & Fine, 1997) and symptom outcomes (Punnett & Wegman, 2004). In some cases, the self-report measures not only correspond to observed measures, but are also more discriminating of pain and function. Additionally, many authors argue that self-reported assessments may be the most valuable approach to measuring WRUE outcomes because of their ability to capture the impact of symptoms on the individual, ease of use in field studies, ability to incorporate diverse symptom patterns/presentations, and evidence for construct validity in ergonomic-epidemiological investigations (Schierhout & Myers, 1996; Punnett & Wegman, 2004). Furthermore, all self-report measures used in this study (both process and outcome) have been fully validated and/or have been demonstrated to be applicable to workers with WRUEDs.

Conclusion

The present randomized controlled trial of three interventions (ergonomics education and adjustments, cognitive-behavioral groups aimed at reducing adverse workstyle responses, and a combination of both the ergonomic and workstyle interventions) compared to a waitlist control for the secondary prevention of WRUESs showed a significant beneficial effect across interventions, but no specific effect of any of the interventions. The results of the present study, the research in the field, and the experiences gained in the conduct of this intervention all suggest that future efforts may benefit from longer-term interventions that address cognitive and behavioral change factors, such as those highlighted in the health beliefs model. These improvements to the interventions may help to increase preventive cognitive and behavioral changes in the challenging workplace environment. Workstyle is a construct that identifies some of the cognitive and behavioral responses to work demands that can increase the likelihood of developing WRUESs, perhaps independently of ergonomic exposures. The workstyle model and measure can be used to provide specific feedback to each individual about his or her responses that may increase risk for upper extremity problems and to help inform a tailored approach to making healthy behavior changes.

Although the workstyle interventions did not produce differential effects in this study, the results demonstrated that workstyle is related to WRUESs. Therefore, further investigations that improve upon the procedures used here should be conducted to determine an optimal approach to reduce adverse workstyle responses in an effort to better manage WRUES and possibly prevent the onset of disorders.

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***Table 1*. Workstyle Score Correlations with Clinical Outcome Measures in the Workstyle Measure Validation Study (*N*=282; Feuerstein et al., 2004)**

	VAS Pain Severity	*Composite Symptoms Score*	*UEFS Functional Limitation*	*SF-12 PCS Physical Health*	*SF-12 MCS Mental Health*
Working Through Pain	0.647**	0.459**	0.554**	-0.414**	-0.258**
Social Reactivity	0.154**	0.171**	0.258**	-0.071	-0.462**
Limited Workplace Support	0.161**	0.143*	0.231**	-0.035	-0.419**
Deadlines/ Pressure	0.223**	0.209**	0.304**	-0.146*	-0.358**
Self-imposed Workpace/ Workload	0.198**	0.107	0.285**	-0.113	-0.243**
Breaks	-0.114	-0.035	-0.118*	0.001	0.080
Mood	0.263**	0.247**	0.306**	-0.062	-0.495**
Pain/ Tension	0.562**	0.417**	0.404**	-0.262**	-0.191**
Autonomic Response	0.236**	0.185**	0.341**	-0.040	-0.360**
Numbness/ Tingling	0.508**	0.463**	0.486**	-0.254**	-0.136*
Characteristic Response to Work	0.370**	0.290**	0.425**	-0.207**	-0.445**
Distress	0.291**	0.260**	0.363**	-0.063	-0.517**
Symptom Response	0.620**	0.498**	0.500**	-0.297**	-0.195**
Total Workstyle Score	0.376**	0.299**	0.435**	-0.197**	-0.473**

* p<0.05
** p<0.01

***Table 2*. A Priori Power Analysis**

Outcome Measures	Pain Symptoms Function Health Productivity
# Treatment Groups	4
# Time Levels	3
Significance Level	0.01[@]
Variance of Means A	13.46*
Variance of Means B	13.15*
Variance of Means AB	4.71*
Common Standard Deviation	14.08*
Effect Size	0.16*
Power A	80%
Power B	85%
Power AB	17%
N per Group	20

Notes: @ = Significance level of 0.05 adjusted by 5 outcome measures to reduce family-wise error
* = Values estimated from Spence, S.H. (1989) Cognitive behavioral therapy in the management of chronic occupational pain of the upper limbs. Beh Res Ther, 27(4), 435-446.

***Table 3*. Intervention Timeline of Activities**

	Baseline	Participation Week 1	Participation Week 2	Participation Week 3	3 Months
Ergonomics Intervention (EI)	Screening and Randomization (Target n=40) • Survey request email	• Ergonomics Evaluation Modification/ Consultation • Ergonomics email	• Ergonomics email	• Ergonomics Follow-up (Modification/ Consultation as needed) • Ergonomics email • Survey request email	• Ergonomics Follow-up Email • Survey request email
Workstyle Intervention (WI)	Screening and Randomization (Target n=40) • Survey request email	• Workstyle Workshop 1 • Ergonomics Evaluation	• Workstyle Workshop 2	• Workstyle Workshop 3 • Ergonomics Evaluation • Workstyle email/ Survey request email	• Survey request email
Workstyle and Ergonomics Intervention (WEI)	Screening and Randomization (Target n=40) • Survey request email	• Ergonomics Evaluation Intervention/ Consultation • Workstyle Workshop 1	• Workstyle Workshop 2	• Workstyle Workshop 3 • Ergonomics Follow-up (Intervention/ Consultation as needed) • Survey request email	• Survey request email
Wait-list Control (WLC)	Screening and Randomization (Target n=40) • Survey request email	• Ergonomics Evaluation		• Ergonomics Evaluation • Survey request email	• Survey request email

***Table 4*. Self-Report Measures and Required Time**

Measure	# Items	Estimated Time Required
BDI-II*	21	5 minutes
BAI*	21	8 minutes
Sociodemographics/Work	21	4 minutes
Workstyle	91	10 minutes
JRPD-24	24	5 minutes
NIOSH Work Stress	9	2 minutes
VAS Pain	1	<1 minute
UEFS	8	1 minutes
SF-12	12	2 minutes
Stanford Presenteeism	6	<1 minute
Sick Days for Symptoms	1	<1 minute
TOTAL	**215**	**36 MINUTES**

***Note: These measures were used only during screening.**

***Table 5*. Participant Characteristics at Baseline**

	Ergonomic Intervention (n=15) M (SD)	**Workstyle Intervention (n=16)** M (SD)	**Workstyle & Ergonomics Intervention (n=16)** M (SD)	**Wait-List Control (n=14)** M (SD)	**Total (n= 61)** M (SD)
Age (in years)	39.3 (10.9)	41.5 (10.9)	43.1 (9.5)	36.5 (9.7)	40.4 (10.4)
Years at Job	6.5 (7.4)	7.9 (7.7)	7.7 (7.9)	3.9 (4.8)	6.7 (7.2)
Hours of Work per Week	39.6 (10.0)	40.7 (10.5)	44.3 (6.9)	38.3 (11.9)	40.9 (9.9)
	n (%)	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Gender					
Females	10 (66.7)	11 (68.8)	9 (56.3)	11 (78.6)	41 (67.2)
Males	5 (33.3)	5 (31.2)	7 (43.8)	3 (21.4)	20 (32.8)
Education					
H.S. Grad/GED	2 (13.3)	1 (6.3)	0 (0.0)	0 (0.0)	3 (4.9)
Some College	1 (6.7)	4 (25.0)	3 (18.8)	3 (21.4)	11 (18.0)
AA/Bachelor's Degree	9 (60.0)	6 (37.5)	5 (31.3)	7 (50.0)	27 (44.3)
Some Graduate School	1 (6.7)	2 (12.5)	3 (18.8)	2 (14.3)	8 (13.1)
Graduate Degree	2 (13.3)	3 (18.8)	5 (31.3)	2 (14.3)	12 (19.7)
Marital Status					
Married	6 (40.0)	11 (68.8)	6 (37.5)	6 (42.9)	29 (47.5)
Single	5 (33.3)	3 (18.8)	8 (50.0)	5 (35.7)	21 (34.4)
Single (Cohabiting)	1 (6.7)	0 (0.0)	1 (6.3)	1 (7.1)	3 (4.9)
Divorced	3 (20.0)	2 (12.5)	1 (6.3)	1 (7.1)	7 (11.5)
Separated	0 (0.0)	0 (0.0)	0 (0.0)	1 (7.1)	1 (1.6)
Race*					
Asian	1 (7.1)	1 (6.7)	0 (0.0)	2 (14.3)	4 (6.9)
Black or African American	3 (21.4)	2 (13.3)	3 (20.0)	2 (14.3)	10 (17.2)
White	8 (57.1)	11 (73.3)	11 (73.3)	9 (64.3)	39 (67.2)
Prefer not to Disclose	2 (14.3)	1 (6.7)	1 (6.7)	1 (7.1)	5 (8.6)
Ethnicity					
Not Hispanic/Latino	12 (80.0)	14 (87.5)	12 (85.7)	21 (92.3)	50 (86.2)
Hispanic/Latino	3 (20.0)	2 (12.5)	2 (14.3)	1 (7.7)	8 (13.8)

*Other race categories (i.e., Native American, Pacific Islander, Multiracial) had no respondents.
Note: Groups were not significantly different on any sociodemographic variable at baseline

***Table 6*. Comparison of Dropouts and Completers on Outcome Measures at Baseline**

	Completed Study[1] (n=42) M (SD)	**Dropout during Study**[2] (n=8) M (SD)	**Dropout at Follow-up**[3] (n=11) M (SD)	**Total** (n= 61) M (SD)
Pain	5.8 (2.3)	5.4 (2.6)	6.3 (2.3)	5.8 (2.3)
Symptoms	102.1 (90.5)	136.3 (148.7)	148.0 (117.8)	115.1 (104.4)
Functional Limitation	17.6 (8.7)	18.3 (7.8)	22.1 (9.8)	18.5 (8.8)
Physical Health	51.3 (7.2)	48.4 (8.1)	51.0 (5.3)	50.8 (7.0)
Mental Health	47.1 (9.2)	56.1 (5.2)*[1]	49.3 (4.4)	48.7 (8.6)
Productivity	11.4 (3.9)	10.9 (3.5)	11.1 (4.7)	11.2 (3.9)
Workstyle	145.1 (36.7)	137.0 (32.2)	138.5 (20.2)	142.9 (33.5)
Ergonomic Exposure	56.1 (10.2)	55.4 (12.1)	57.0 (7.3)	56.1 (9.9)
Work Stress	30.4 (5.3)	31.4 (6.1)	31.2 (3.7)	30.7 (5.1)

* Denotes significant difference ($p<0.05$) between participants completing study and those dropping out during the study.

Table 7. Validity Examinations

Meeting	Workstyle Score	Ergonomic Score
Workstyle meeting 1	141	N/A
Workstyle meeting 2a	145	N/A
Workstyle meeting 2b	158	N/A
Workstyle meeting 3	134	N/A
Ergonomic visit 1	N/A	30
Ergonomic visit 2	N/A	32
Ergonomic visit 3	N/A	32
Ergonomic visit 4	N/A	30

Table 8. Results for Outcome and Process Measures at Baseline, Post-test, and 3 Months

	Ergonomics Intervention (EI)	**Workstyle Intervention (WI)**	**Workstyle & Ergonomics Intervention (WEI)**	**Wait-List Control (WLC)**
	M (SD)	M (SD)	M (SD)	M (SD)
VAS Pain				
Baseline	5.5 (2.3)	6.3 (2.5)	5.6 (2.5)	5.9 (2.3)
Post-test	4.4 (2.6)	6.0 (2.8)	5.5 (3.0)	5.4 (2.8)
3 Months	3.3 (1.3)	5.3 (2.7)	3.8 (1.8)	5.8 (2.8)
NIOSH Symptoms				
Baseline				
Post-test	81.0 (92.1)	138.5 (110.1)	95.5 (110.4)	109.7 (97.8)
3 Months	102.3 (153.3)	136.3 (113.3)	69.5 (66.4)	80.6 (71.7)
	31.4 (17.0)	99.6 (99.2)	62.3 (67.1)	86.0 (71.5)
UEFS Functional Limitation				
Baseline	17.1 (9.6)	21.4 (11.0)	15.2 (4.4)	17.4 (7.7)
Post-test	22.7 (16.9)	24.8 (14.8)	13.8 (4.2)	17.1 (7.5)
3 Months	17.0 (7.6)	17.0 (8.2)	12.0 (5.9)	19.8 (10.9)
SF12 PCS				
Baseline	49.7 (8.4)	48.6 (6.4)	55.3 (5.2)	53.5 (6.7)
Post-test	50.6 (6.5)	49.2 (8.5)	54.6 (4.9)	50.9 (4.9)
3 Months	54.6 (5.0)	52.0 (5.1)	54.2 (6.9)	50.9 (6.7)
SF12 MCS				
Baseline	49.6 (7.1)	52.1 (7.7)	45.2 (9.8)	42.8 (10.5)
Post-test	48.6 (7.2)	50.4 (5.1)	44.3 (7.8)	44.4 (12.5)
3 Months	45.1 (12.9)	52.6 (6.5)	46.7 (6.3)	46.0 (10.3)
SPS 6 Productivity				
Baseline				
Post-test	10.7 (4.2)	11.0 (2.9)	11.6 (3.3)	12.2 (4.2)
3 Months	11.2 (4.1)	13.6 (3.8)	12.4 (3.7)	12.3 (5.3)
	10.7 (5.3)	11.3 (3.9)	9.9 (4.0)	13.1 (5.5)
Workstyle				
Baseline	136.9 (25.5)	154.7 (40.6)	151.6 (36.8)	138.4 (45.4)
Post-test	129.4 (24.7)	146.5 (30.5)	149.5 (38.7)	129.3 (41.2)
3 Months	124.0 (28.4)	127.0 (34.7)	131.0 (31.3)	126.1 (38.4)
JRPD Ergo Exposure				
Baseline				
Post-test	53.6 (9.3)	59.7 (11.0)	53.5 (9.9)	56.1 (12.2)
3 Months	47.4 (7.8)	57.1 (10.8)	46.7 (9.7)	56.1 (14.6)
	48.5 (7.6)	51.0 (10.7)	45.5 (8.4)	52.7 (14.4)
NIOSH Work Stress				
Baseline				
Post-test	30.0 (5.1)	31.8 (6.6)	30.9 (6.0)	28.4 (2.1)
3 Months	29.2 (4.9)	33.5 (6.2)	30.4 (5.8)	27.7 (2.7)
	31.6 (4.6)	30.7 (8.7)	28.7 (7.9)	28.9 (6.6)
Screening Measures				
BDI	4.9 (4.6)	1.8 (1.8)	4.4 (4.7)	5.4 (6.7)
BAI	5.8 (3.4)	2.9 (2.3)	4.9 (3.9)	5.7 (3.9)

***Table 9*. Post Hoc Examinations of Significant Main Effects**

Time Effects Post Hoc			
	Baseline[1]	**Post-test[2]**	**3 Months[3]**
Pain	5.9	5.4	4.5*[1,2]
Symptoms	109.6	100.0	71.8*[1]
Workstyle	145.4	138.7*[1,3]	127.0*[1,2]
JRPD	55.8*[2,3]	51.8	49.4
Group Effect Post Hoc Efficacy			
Ergonomics Intervention[EI]	**Workstyle Intervention[WI]**	**Workstyle & Ergonomics Intervention[WEI]**	**Waitlist Control[WLC]**
3.1	2.8*[EI, WEI]	3.3	1.5*[EI, WI, WEI]

* denotes significant difference (p<0.05)

***Table 10*. Bivariate Correlations Among Key Process and Outcome Measures**

	Pain	**Symptoms**	**Productivity**	**Ergo Exposure**	**Stress**	**Workstyle**
Pain	1.0					
Symptoms	0.48**	1.0				
Productivity	0.15	-0.05	1.0			
Ergo Exposure	0.08	-0.05	-0.41**	1.0		
Stress	0.49**	0.33*	-0.03	0.19	1.0	
Workstyle	0.54**	0.30	-0.03	0.29	0.66**	1.0
Workstyle Without WS1	0.49**	0.17	0.01	0.27	0.61**	0.97**

* denotes p<0.05
** denotes p<0.01
Note: Workstyle Without WS1 is the workstyle score without the Working Through Pain subscale

Table 11. Bivariate Correlations Among the Change in Key Process and Outcome Measure Scores

	Pain Δ	**Symptoms Δ**	**Productivity Δ**	**Ergo Exposure Δ**	**Stress Δ**	**Workstyle Δ**
Pain Δ	1.0					
Symptoms Δ	0.32*	1.0				
Productivity Δ	0.09	0.10	1.0			
Ergo Exposure Δ	-0.01	0.11	0.30	1.0		
Stress Δ	0.05	-0.15	0.31	0.24	1.0	
Workstyle Δ	0.38*	0.36*	0.28	0.19	0.43**	1.0
Workstyle Without WS1 Δ	0.38*	0.21	0.33*	0.16	0.49**	0.92**

* denotes *p*<0.05
** denotes *p*<0.01
Note: Workstyle Without WS1 is the workstyle score without the Working Through Pain subscale

Table 12. Power Analysis for Present Study

	Single Outcome Measure
# Treatment Groups	4
# Time Levels	3
Significance Level	0.05
Variance of Means A	0.35
Variance of Means B	0.28
Variance of Means AB	0.15
Common Standard Deviation	2.9
Power A	46%
Power B	43%
Power AB	16%
N per Group	11

Table 13. Power Analysis for Future Studies

	Single Outcome Measure
# Treatment Groups	4
# Time Levels	3
Significance Level	0.05
Variance of Means A	0.35
Variance of Means B	0.28
Variance of Means AB	0.15
Common Standard Deviation	2.9
Power A	80%
Power B	76%
Power AB	32%
N per Group	23

***Figure 1*. Balance Theory of Job Design and Stress (Carayon, Smith, & Haims, 1999)**

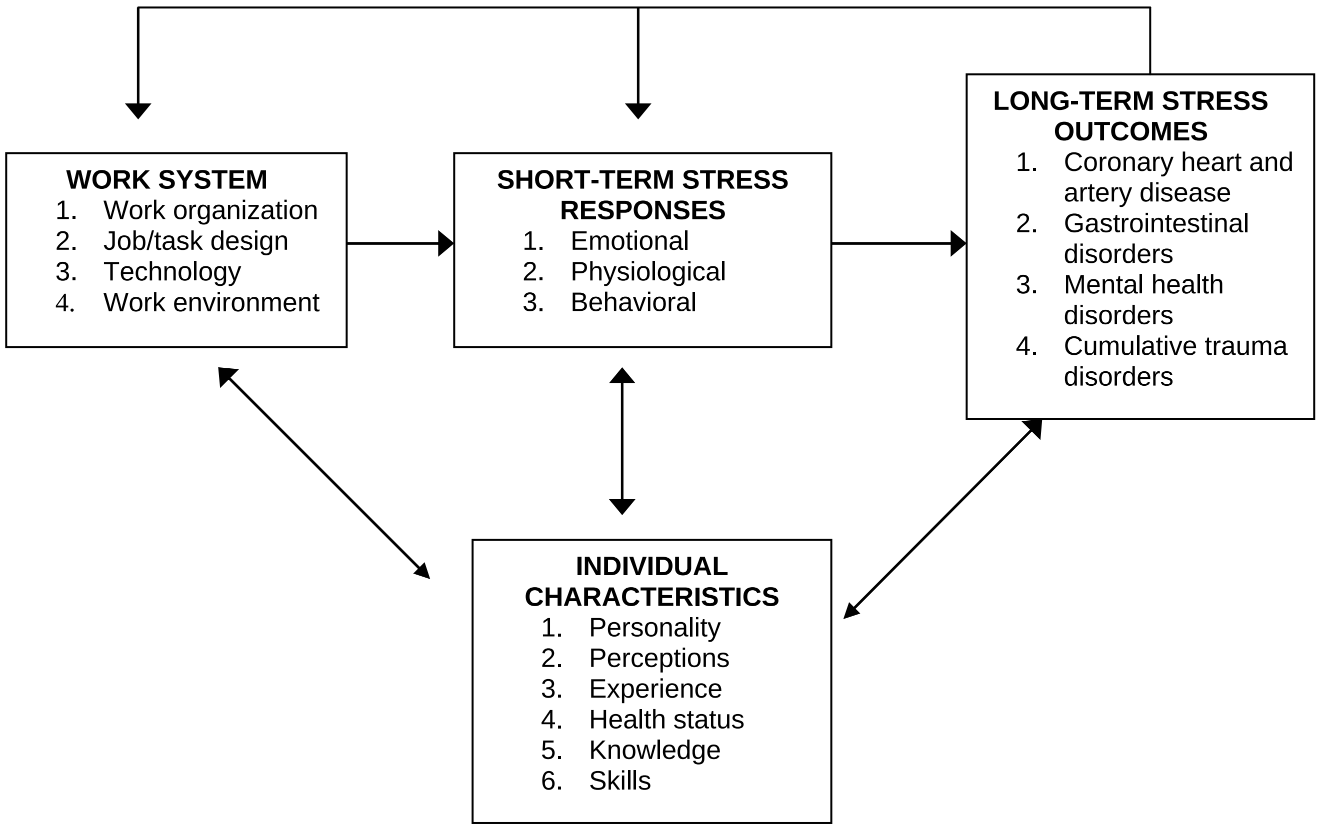


Figure 2. **Biopsychosocial Model of Job Stress (Melin & Lundberg, 1997)**

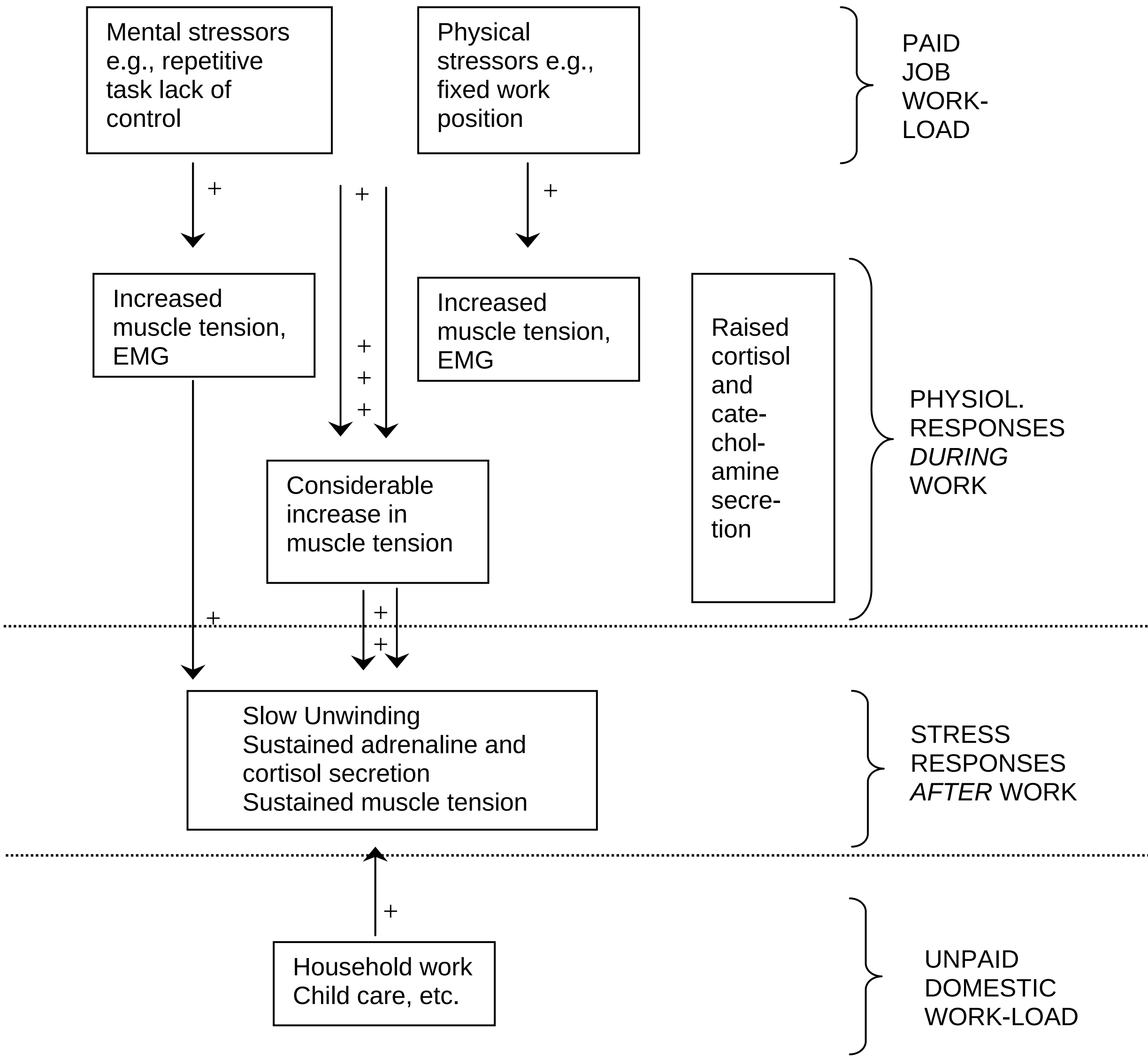


***Figure 3*. Ecological Model of Musculoskeletal Disorders (Sauter & Swanson, 1996)**

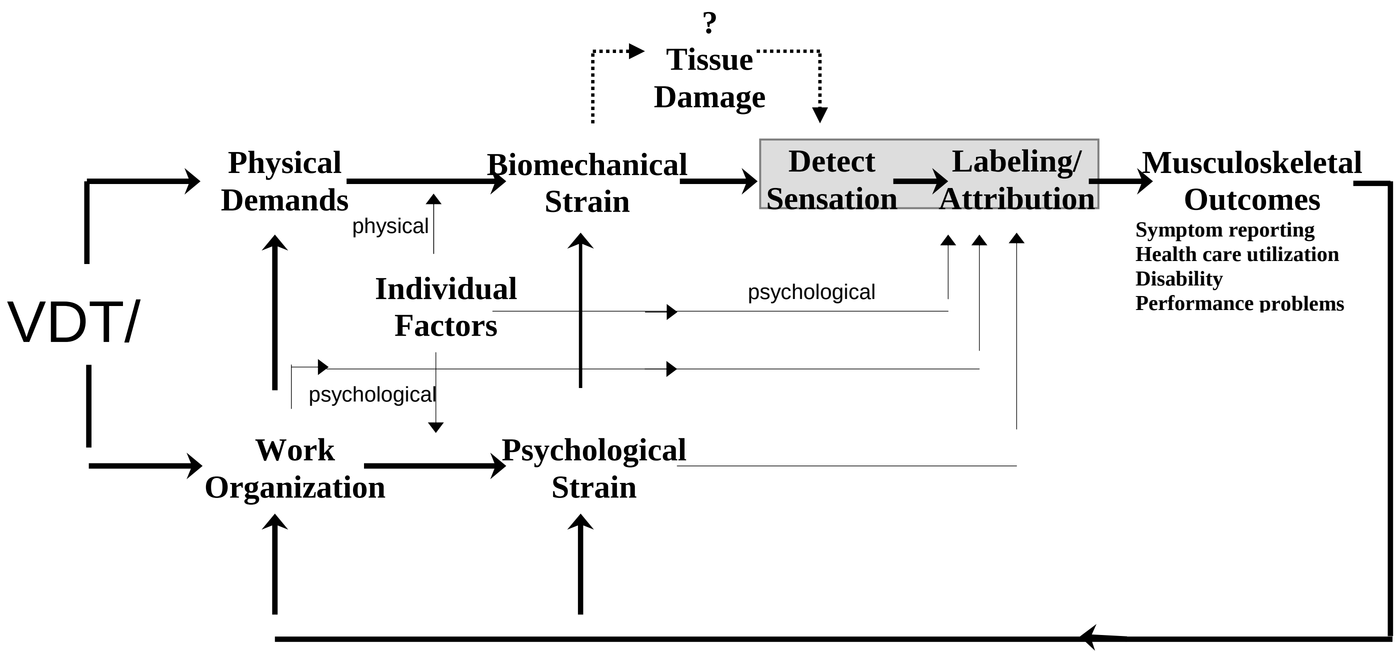


Figure 4. **Workstyle Model (Feuerstein, Huang, & Pransky, 1999)**

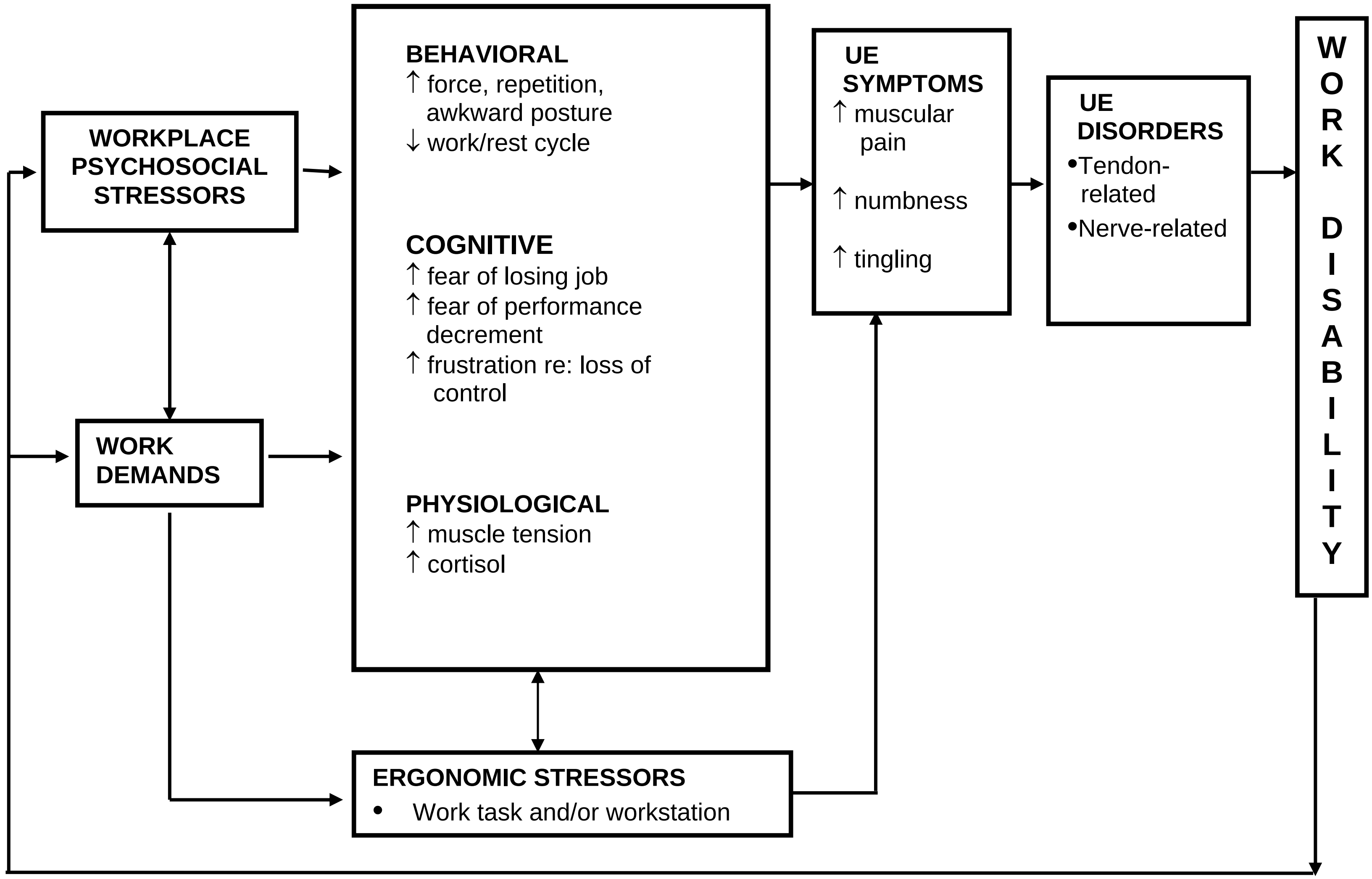
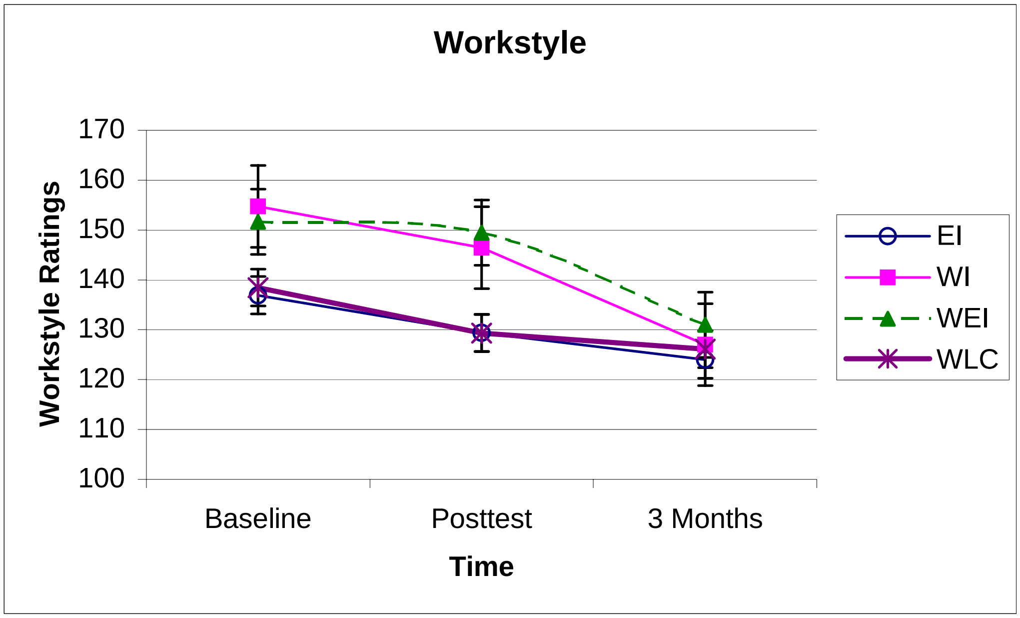
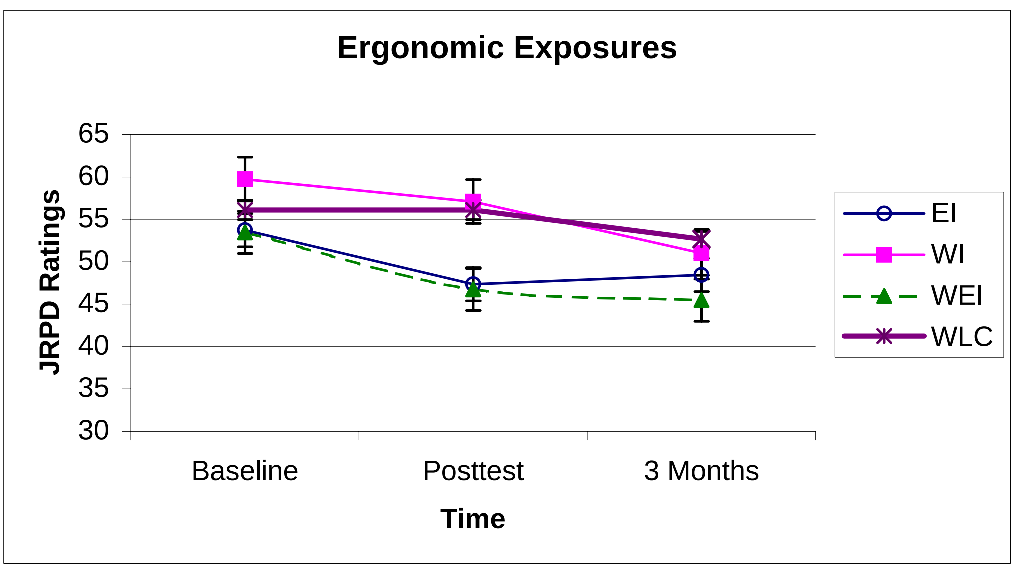


***Figure 5*. Mean Workstyle Ratings by Group Over Time**



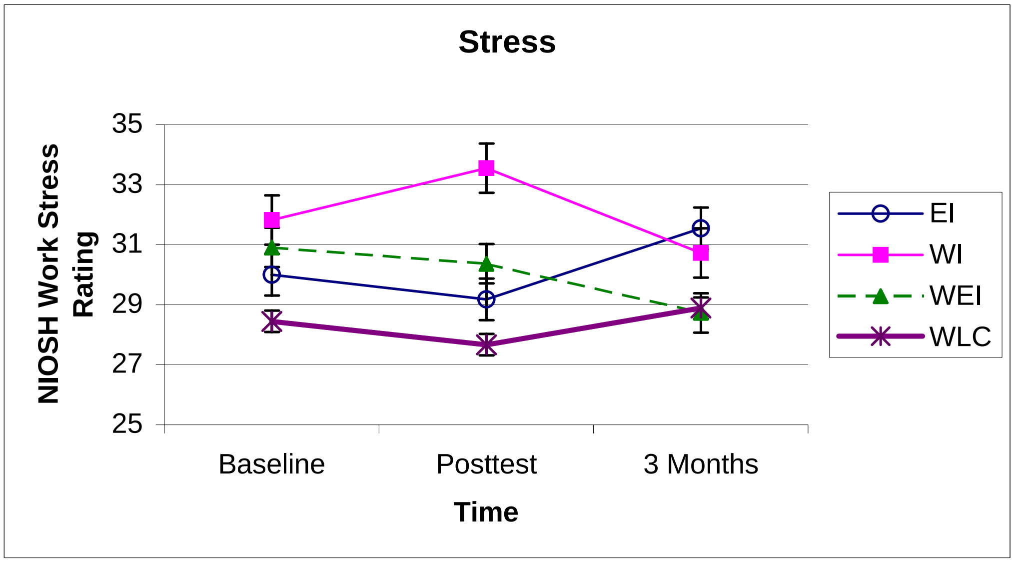
Note: EI=Ergonomic Intervention; WI=Workstyle Intervention; WEI=Workstyle & Ergonomics Intervention; WLC=Waitlist Control

***Figure 6*. Mean Ergonomic Exposure Ratings by Group Over Time**



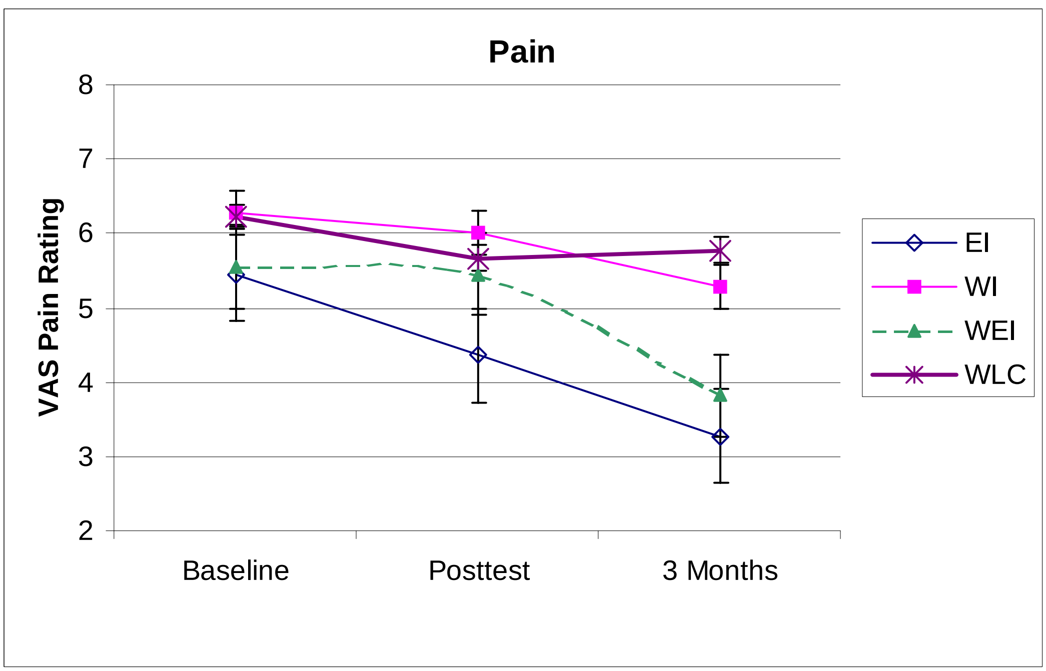
Note: EI=Ergonomic Intervention; WI=Workstyle Intervention; WEI=Workstyle & Ergonomics Intervention; WLC=Waitlist Control

***Figure 7*. Mean Work Stress Ratings by Group Over Time**



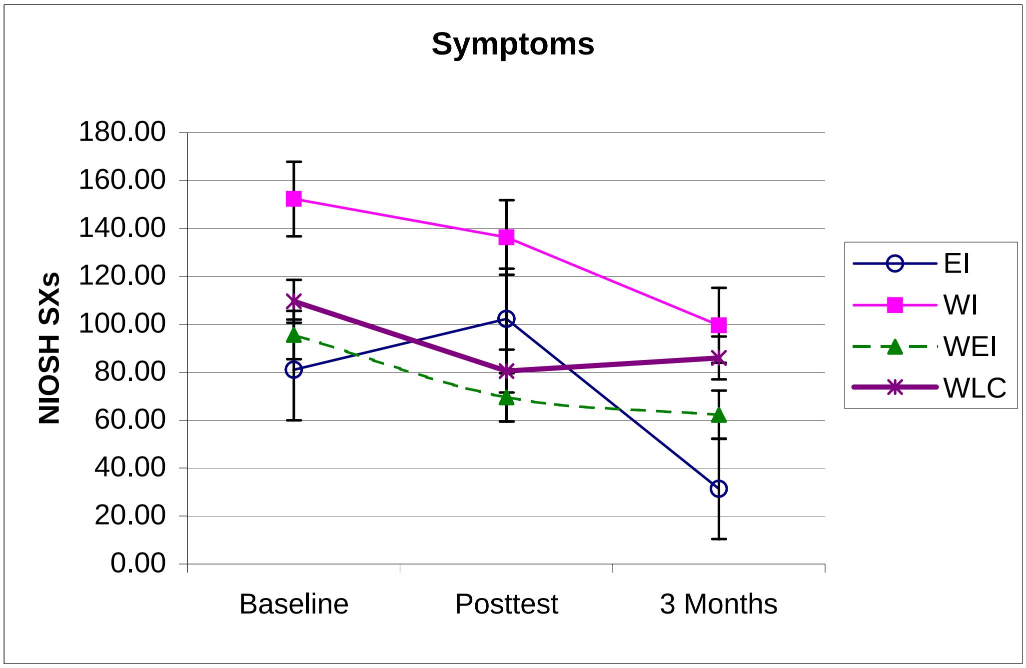
Note: EI=Ergonomic Intervention; WI=Workstyle Intervention; WEI=Workstyle & Ergonomics Intervention; WLC=Waitlist Control

***Figure 8*. Mean Pain Ratings by Group Over Time**



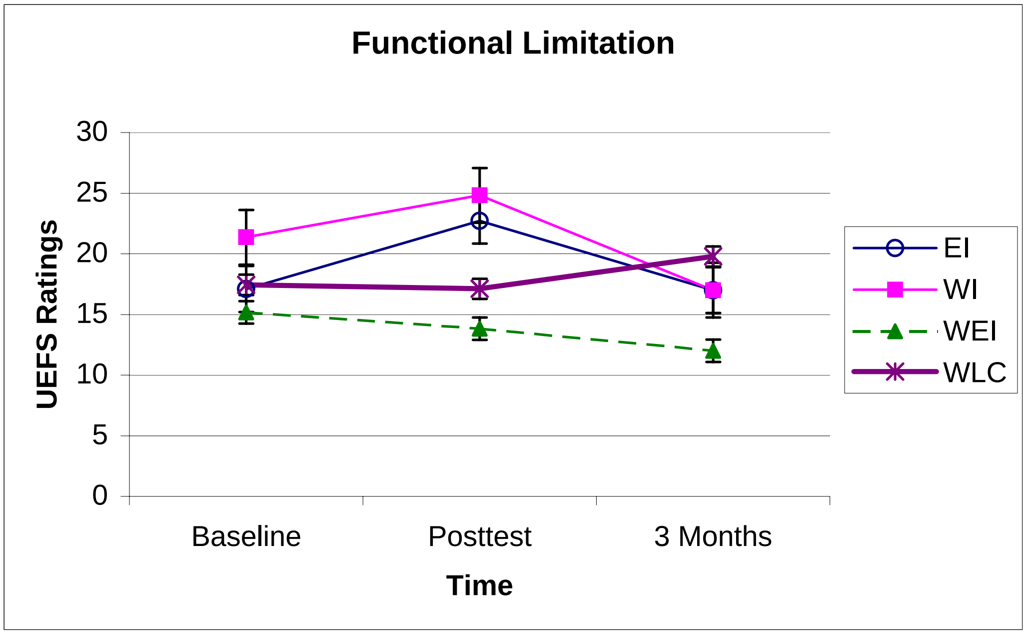
Note: EI=Ergonomic Intervention; WI=Workstyle Intervention; WEI=Workstyle & Ergonomics Intervention; WLC=Waitlist Control

***Figure 9*. Mean Symptoms Ratings by Group Over Time**



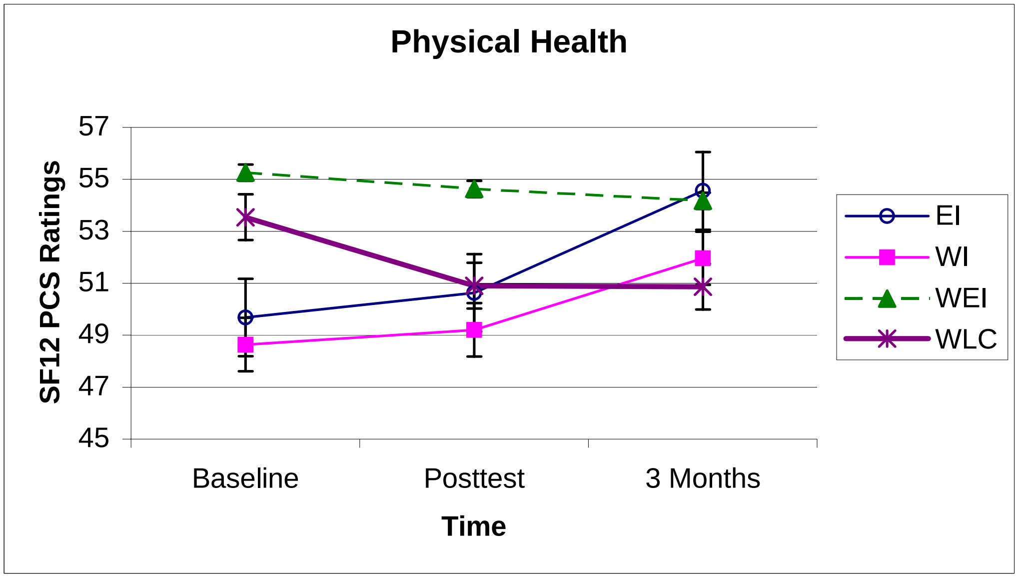
Note: EI=Ergonomic Intervention; WI=Workstyle Intervention; WEI=Workstyle & Ergonomics Intervention; WLC=Waitlist Control

***Figure 10*. Mean Functional Limitation Ratings by Group Over Time**



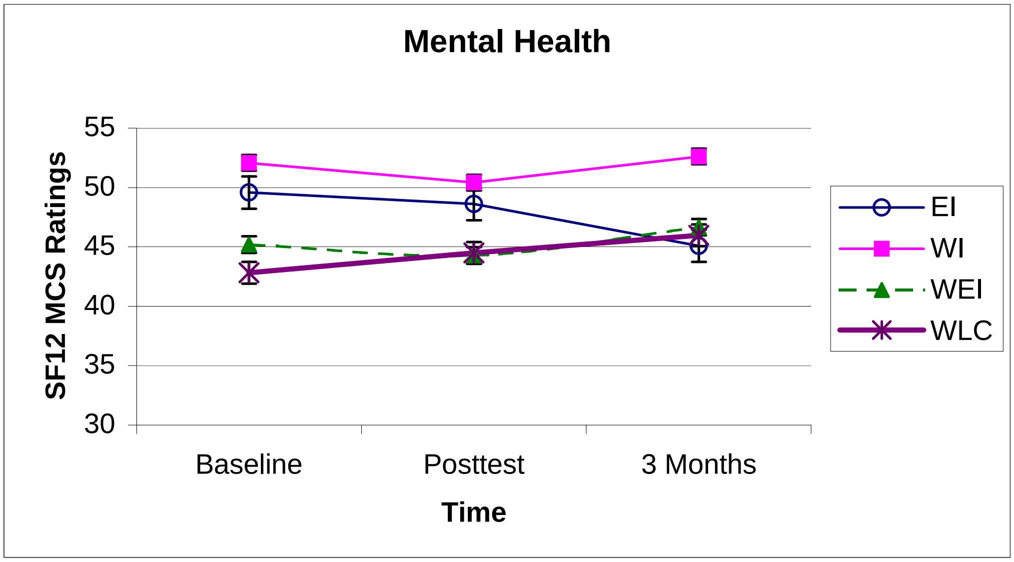
Note: EI=Ergonomic Intervention; WI=Workstyle Intervention; WEI=Workstyle & Ergonomics Intervention; WLC=Waitlist Control

***Figure 11*. Mean Physical Health Ratings by Group Over Time**



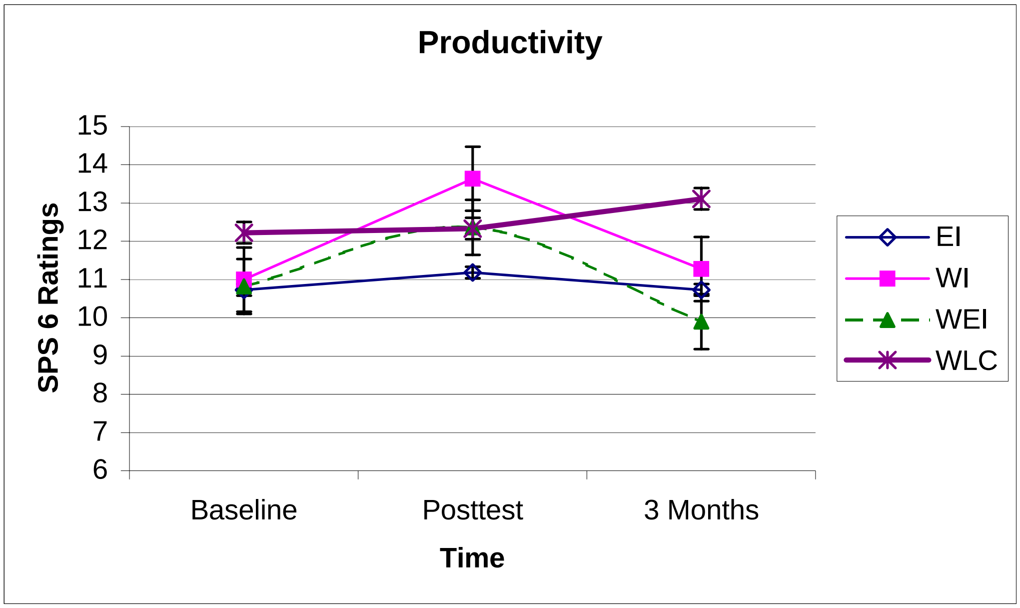
Note: EI=Ergonomic Intervention; WI=Workstyle Intervention; WEI=Workstyle & Ergonomics Intervention; WLC=Waitlist Control

***Figure 12*. Mean Mental Health Ratings by Group Over Time**



Note: EI=Ergonomic Intervention; WI=Workstyle Intervention; WEI=Workstyle & Ergonomics Intervention; WLC=Waitlist Control

***Figure 13*. Mean Productivity Ratings by Group Over Time**



Note: EI=Ergonomic Intervention; WI=Workstyle Intervention; WEI=Workstyle & Ergonomics Intervention; WLC=Waitlist Control

Appendix 1. Screening Form

INTRODUCTION (read to participant)

Research has shown that work-related upper extremity symptoms and disorders can be related to aspects of the workplace such as the way the workstation is designed and the way the worker has to move to perform job tasks. Also, the amount of stress in the workplace can affect how one responds to work demands. Workstyle is a way of describing this process and is a description of HOW a person works in response to these aspects of the job. The purpose of this study is to determine if an intervention program that helps you change your workstyle can reduce or eliminate your upper extremity symptoms. Computer users who have symptoms in their hands/fingers, wrists, arms, elbows, shoulders, or neck will be asked to participate in an intervention program that includes either workstyle, ergonomic intervention, both, or neither with access to usual care followed by the most effective treatment when the study ends.

This study will begin by having you report your levels of job stress, ergonomic exposures, and workstyle, along with symptoms, function, and productivity ratings on an online survey that should take about 15-25 minutes to complete. After the first survey, you will receive one of the four interventions mentioned earlier. You will have an ergonomist visit and evaluate your workstation at your workplace for about 20 minutes a total of 4 times. This must be approved in advance by you and your workplace supervisor. In some cases, you will also attend 90-minute group meetings once a week for four weeks. After the visits, you will be asked to return to the website and complete the surveys again. We will ask you to complete the website surveys twice more, once 3 months after the visits, and once 12 months after the visits. This will result in you taking the survey for a total of four times. The visits will be conducted by doctoral students in clinical psychology who are supervised by a licensed clinical psychologist with extensive experience and internationally-recognized expertise in studying these problems. You will be paid $10 each time you complete the online survey for a total of $40 and will also benefit from free enrollment in established and/or promising new interventions for upper extremity symptoms. All information collected during the study is coded and your name will not appear on any records. Do you have any questions? If you are interested in participating in this study I now need to ask you a series of questions to determine if you are the type of person we are looking for: Are you interested?" (If yes, get the following information. If no, thank the caller and discontinue the screening.)

NAME ____

EMAIL ADDRESS ____

WORK PHONE ___________________________________

OFFICE NUMBER: ______________________

WORK ADDRESS:____

AGE __________

BMI(from chart)________________

Do you work on computers a minimum of 4 hours per day? YES NO

Are you employed at least 32 hours per week? YES NO

Do you have pain, aching, stiffness, burning, tingling, and/or numbness in the fingers, hands, wrists, forearms, elbows, shoulders, and/or neck that lasted for 2 or more days at least twice a month for the past year? YES NO

IF YES, Did you ever have an accident or sudden injury to the area(s) where you experience symptoms such as a deep cut, sports injury, fracture, or tendon tear not related to your work? YES NO

Has a doctor ever diagnosed you with inflammatory arthritis, thyroid disease, or diabetes mellitus? YES NO

If you are female, are you currently pregnant or have you been pregnant in the past 12 months? YES NO

Would you be willing to provide information about your stress, ergo risk, workstyle, symptoms, and function on the online survey? YES NO

Would you be willing to attend 90 minute workshops during your lunch break once a week for four weeks? YES NO

Thank you for your interest in the Workstyle Study. If you have any questions or concerns, please contact the researchers at workstyle_study@hotmail.com

Screening: BDI-II/BAI

(Note: BDI-II/BAI reproduced here for review purposes only. Original surveys were used in the study with purchase agreement from The Psychological Corporation)

BDI-II

Instructions: This questionnaire consists of 21 groups of statements. Please read each group of statements carefully, and then pick out the one statement in each group that best describes the way you have been feeling during the past two weeks, including today. Check the box beside the statement you have picked. If several statements in the group seem to apply equally well, choose the last statement for that group. Be sure that you do not choose more than one statement for any group including item 16 (Changes in Sleeping Pattern) or item 18 (Changes in Appetite).

1. Sadness
    - [ ] I do not feel sad
    - [ ] I feel sad much of the time
    - [ ] I am sad all the time
    - [ ] I am so sad or unhappy that I can't stand it

2. Pessimism
    - [ ] I am not discouraged about my future
    - [ ] I feel more discouraged about my future than I used to be
    - [ ] I do not expect things to work out for me
    - [ ] I feel my future is hopeless and will only get worse

3. Past Failure
    - [ ] I do not feel like a failure
    - [ ] I have failed more than I should have
    - [ ] As I look back, I see a lot of failures
    - [ ] I feel I am a total failure as a person

4. Loss of Pleasure
    - [ ] I get as much pleasure as I ever did from the things I enjoy
    - [ ] I don't enjoy things as much as I used to
    - [ ] I get very little pleasure from the things I used to enjoy
    - [ ] I can't get any pleasure from the things I used to enjoy

5. Guilty Feelings
    - [ ] I don't feel particularly guilty
    - [ ] I feel guilty over many things I have done or should have done
    - [ ] I feel quite guilty most of the time
    - [ ] I feel guilty all of the time

6. Punishment Feelings
    - [ ] I don't feel I am being punished
    - [ ] I feel that I may be punished
    - [ ] I expect to be punished
    - [ ] I feel I am being punished

7. Self-Dislike
    - [ ] I feel the same about myself as ever
    - [ ] I have lost confidence in myself
    - [ ] I am disappointed in myself
    - [ ] I dislike myself

8. Self-Criticalness
    - [ ] I don't criticize or blame myself more than usual
    - [ ] I am more critical of myself than I used to be
    - [ ] I criticize myself for all of my faults
    - [ ] I blame myself for everything bad that happens

9. Suicidal Thoughts or Wishes
    - [ ] I don't have any thoughts of killing myself
    - [ ] I have thoughts of killing myself but I would not carry them out
    - [ ] I would like to kill myself
    - [ ] I would kill myself if I had the chance

10. Crying
    - [ ] I don't cry anymore than I used to
    - [ ] I cry more than I used to
    - [ ] I cry over every little thing
    - [ ] I feel like crying but I can't

11. Agitation
    - [ ] I am no more restless or wound up than usual
    - [ ] I feel more restless or wound up than usual
    - [ ] I am so restless or agitated that it's hard to stay still
    - [ ] I am so restless or agitated that I have to keep moving or doing something

12. Loss of Interest
    - [ ] I have not lost interest in other people or activities
    - [ ] I am less interested in other people or things than before
    - [ ] I have lost most of my interest in other people or things
    - [ ] It's hard to get interested in anything

13. Indecisiveness
    - [ ] I make decisions about as well as ever
    - [ ] I find it more difficult to make decisions than usual
    - [ ] I have greater difficulty in making decisions than I used to

[ ] I have trouble making any decisions

14. Worthlessness
    [ ] I do not feel I am worthless
    [ ] I don’t consider myself as worthwhile and useful as I used to
    [ ] I feel more worthless compared to other people
    [ ] I feel utterly worthless

15. Loss of Energy
    [ ] I have as much energy as ever
    [ ] I have less energy than I used to have
    [ ] I don’t have enough energy to do very much
    [ ] I don’t have enough energy to do anything

16. Changes in Sleeping Pattern
    [ ] I have not experienced any change in my sleeping pattern
    [ ] I sleep somewhat more than usual
    [ ] I sleep somewhat less than usual
    [ ] I sleep a lot more than usual
    [ ] I sleep a lot less than usual
    [ ] I sleep most of the day
    [ ] I wake up about 1-2 hours early and can’t get back to sleep

17. Irritability
    [ ] I am no more irritable than usual
    [ ] I am more irritable than usual
    [ ] I am much more irritable than usual
    [ ] I am irritable all the time

18. Changes in Appetite
    [ ] I have not experienced any change in my appetite
    [ ] My appetite is somewhat less than usual
    [ ] My appetite is somewhat greater than usual
    [ ] My appetite is much less than before
    [ ] My appetite is much greater than usual
    [ ] I have no appetite at all
    [ ] I crave food all the time

19. Concentration Difficulty
    [ ] I can concentrate as well as ever
    [ ] I can’t concentrate as well as usual
    [ ] It’s hard to keep my mind on anything for very long
    [ ] I find I can’t concentrate on anything

20. Tiredness or Fatigue
    - [ ] I am no more tired or fatigued than usual
    - [ ] I get more tired or fatigued more easily than usual
    - [ ] I am too tired or fatigued to do a lot of the things I used to
    - [ ] I am too tired or fatigued to do most of the things I used to

21. Loss of Interest in Sex
    - [ ] I have not noticed any recent change in my interest in sex
    - [ ] I am less interested in sex than I used to be
    - [ ] I am much less interested in sex now
    - [ ] I have lost interest in sex completely

BAI

Instructions: Below is a list of common symptoms of anxiety. Please carefully read each item in the list. Indicate how much you have been bothered by each symptom during the past week, including today by selecting the box in the corresponding space next to each symptom.

	Not At All	Mildly It did not bother me much	Moderately It was very unpleasant but I could stand it	Severely I could barely stand it
1. Numbness or tingling	[ ]	[ ]	[ ]	[ ]
2. Feeling hot	[ ]	[ ]	[ ]	[ ]
3. Wobbliness in legs	[ ]	[ ]	[ ]	[ ]
4. Unable to relax	[ ]	[ ]	[ ]	[ ]
5. Fear of the worst happening	[ ]	[ ]	[ ]	[ ]
6. Dizzy or lightheaded	[ ]	[ ]	[ ]	[ ]
7. Heart pounding or racing	[ ]	[ ]	[ ]	[ ]
8. Unsteady	[ ]	[ ]	[ ]	[ ]
9. Terrified	[ ]	[ ]	[ ]	[ ]
10. Nervous	[ ]	[ ]	[ ]	[ ]
11. Feeling of Choking	[ ]	[ ]	[ ]	[ ]
12. Hands trembling	[ ]	[ ]	[ ]	[ ]
13. Shaky	[ ]	[ ]	[ ]	[ ]
14. Fear of losing control	[ ]	[ ]	[ ]	[ ]
15. Difficulty breathing	[ ]	[ ]	[ ]	[ ]
16. Fear of dying	[ ]	[ ]	[ ]	[ ]
17. Scared	[ ]	[ ]	[ ]	[ ]
18. Indigestion or discomfort in abdomen	[ ]	[ ]	[ ]	[ ]
19. Faint	[ ]	[ ]	[ ]	[ ]
20. Face flushed	[ ]	[ ]	[ ]	[ ]
21. Sweating (not due to heat)	[ ]	[ ]	[ ]	[ ]

Appendix 2. Participant Screening Emails

1. Excluded Participants

Thank you for your interest in the Workstyle Study. Unfortunately, at this time you do not meet the inclusion criteria that are under consideration for this study. We recommend that you contact your healthcare provider and/or occupational health personnel at the workplace regarding your symptoms. Please feel free to contact the researchers at workstyle_study@hotmail.com or 301-295-9660 with any questions you may have.

(If participant is excluded for mental health reasons, the following statement is added: We recommend that you contact you primary care provider who can assist you for your mood/anxiety symptoms that you reported.)

2. Included Participants

Thank you for your interest in the Workstyle Study. We would like you to complete our online survey at http://131.158.28.200/mps/index.tpx (*usuhs.mil website with firewall protection*) where our survey regarding work stress and health is maintained. This survey is intended to gain information about the stressors in your environment and your upper extremity health. Instead of your name, you will be asked to provide your participant ID number. Your assigned number will be:

(1,2,3,4)(###) (First Initial)(Last Initial).

This number will be the way that you are identified in the database to protect your privacy. Please keep this email so that you can provide the correct ID number. The survey will take 15-25 minutes to complete. Once you complete the survey, our staff will mail you a $10 check to your mailing address.

**If individual is randomized to WI or WEI group, add: You have also been scheduled to attend the workstyle intervention workshops on DATE, TIME. The first workshop is scheduled for DATE TIME.)

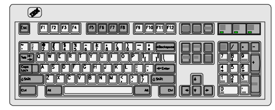
Thank you again for your participation in this study. Please contact the researchers at workstyle_study@hotmail.com or at 301-295-9660 with any questions or concerns.

Appendix 3. Ergonomics Assessment Checklist

Date:________________	Employee name: ____	
Employee number:	Job Title:	Office Phone:____________________
_____________________	_______________________	Email:___________________________
Analyzed by:___________	Evaluation:	Number of years at this job:_________
Office number:_________	❑ Baseline	Previous experience in similar job:___
Score (# "No"):________	❑ Post-test	Recent change(s) in workstation:
Study ID:_____________	❑ 3 month follow-up	_________________________________
Time:________________	❑ 12 month follow-up	Time at this workstation:_____months

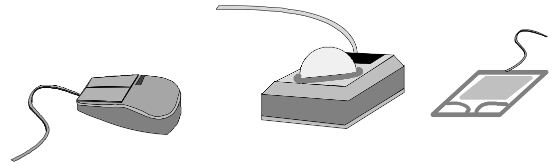
<u>Instructions to evaluator:</u> Please complete the worksheet regarding the following aspects of an individual's workstation: keyboard, input devices, monitor, other office equipment, paper documents, chairs, workspace, environment, and lifting/carrying. Because the questions are designed to identify major inadequacies of the workstation design, respond to the questions in the spirit intended rather than a literal assessment. For example, if a worker's posture could be slightly improved but is comfortable and within 5° of neutral posture, then it is probably not necessary to intervene. If the response to a question is "No," please either circle the appropriate recommendation or write out the recommendation in the "Other" space. It is suggested ***not*** to cue the worker to assume a "normal" working posture as this may result in a better posture than is usually maintained. Thank you.

Keyboard



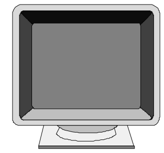
Questions		Recommended Solutions
Is the keyboard located so that the wrists are in a neutral posture (not bent up, down or to the side) while typing?	☐ NO ⇨ ☐ YES ⇩	• Adjust seat height so that elbows are at the same height as the keyboard. • Raise or lower adjustable worksurfaces in systems furniture so that they are just below seated elbow height. • Place keyboard and mouse on articulating keyboard tray and adjust tray height and tilt until wrists are working in neutral posture. • Other ____
Is the keyboard at a height which places the forearms approximately parallel with the floor?	☐ NO ⇨ ☐ YES ⇩	• Adjust seat height so that elbows are at the same height as the keyboard. • Raise or lower adjustable worksurfaces in systems furniture so that they are just below seated elbow height. • Place keyboard and mouse on articulating keyboard tray and adjust tray height and tilt until wrists are working in neutral posture. • Other ____
Does a wrist rest support the wrists during pauses in typing?	☐ NO ⇨ ☐ YES ⇩	• Use a wrist rest for support during pauses in typing. • Use armrests on the chair for forearm support during pauses in typing. • Other ____
Is the wrist rest padded and covered with a soft, non-irritating fabric?	☐ NO ⇨ ☐ YES ⇩ ☐ N/A ⇩	• Replace hard wrist rests or wrist rests with worn fabric with new, padded wrist rests. • Pad sharp edges on keyboard trays with foam (e.g. - pipe insulation) as long as thickness does not affect wrist posture. • Other ____
Are the upper arms and elbows close to the sides of the body when the hands are on the keyboard?	☐ NO ⇨ ☐ YES ⇩	• Remove any obstacles (desk drawers, boxes, waste baskets) that prevent sitting close to keyboard. • Avoid using chair armrests that are farther apart than shoulder width. • Lower keyboard worksurface to seated elbow level. Other ____
Are the shoulders even *(not elevated)* when the hands are on the keyboard?	☐ NO ⇨ ☐ YES ⇩	• Lower or remove armrests that are too high and don't allow the arms to hang down naturally. • Raise chair and provide footrest if feet are not fully supported by the floor. • Lower keyboard worksurface to seated elbow level. • Other ____

Input Devices (Mouse/Trackball/Touch Pad)



Questions	Recommended Solutions
Is the input device (mouse / trackball / touch pad) directly to the side of the keyboard? ☐ NO ⇨ ☐ YES ⇩	• Use keyboard shortcuts to reduce the number of reaches to other input devices. • Use input device with the other hand (e.g. - switch to left-handed use if right-handed). • Clear off desk space or relocate computer to provide room for the input device. • Use a keyboard tray that is wide enough to accommodate the input device, or attach adapter to current keyboard tray. • Use a voice navigation program with voice commands in place of input device use. • Other ______________________________
Is the input device located at the same height as or slightly higher than the keyboard? ☐ NO ⇨ ☐ YES ⇩	If you need to raise the input device: • Place input device on top of book or stack of papers. • Use a platform that places the input device over the keyboard 10-key. If you need to lower the input device: • Use a keyboard tray that is wide enough to accommodate the input device, or attach adapter to current keyboard tray. • Use a platform that places the input device over the keyboard 10-key. • Other ______________________________
Does the mouse/trackball move freely and is it well maintained? ☐ NO ⇨ ☐ YES ⇩	• Remove and clean mouse ball or trackball. • Check cables to make sure they are fully plugged in. • Other ______________________________
Is software available to customize the input device? ☐ NO ⇨ ☐ YES ⇩	• Install software and customize cursor velocity, acceleration and size. • Assign click and drag or double click functions on programmable input devices. • Other ______________________________
Is a loose grip used on the mouse or other input device? ☐ NO ⇨ ☐ YES ⇩	• Let go of the mouse when not actively using it. • Switch to using keyboard shortcuts instead of pull-down or pop-up menus. • Use a mouse or other input device that is designed to better fit the hand. • Other ______________________________

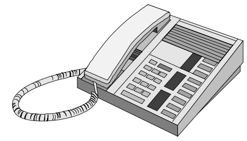
Monitor



Questions		Recommended Solutions
Can the monitor screen be viewed without tilting the head up at all or more than slightly down?	☐ NO ⇨ ☐ YES ⇩	If you need to raise the monitor: • Place it on top of the CPU. • Place it on top of reams of paper. • Use a monitor stand or arm. If you need to lower the monitor: • Remove tilt/swivel stand and tilt with a book under the front edge. • Lower monitor work surface. • Cut into work surface and lower portion for monitor. • Other ______________________________
Is the monitor in line with the keyboard and chair so that it can be viewed by looking straight ahead?	☐ NO ⇨ ☐ YES ⇩	• If the monitor is viewed the most, center it directly in front of the QWERTY portion of the keyboard. • If documents are viewed more often, place the monitor just to the side and angled in. • Other ______________________________
Is the monitor close enough to read from comfortably?	☐ NO ⇨ ☐ YES ⇩	• Sit close enough to monitor to read without leaning forward. • Use a larger font size for text and zoom in on graphics. • Have annual vision exams and make sure any prescription lenses are suited to computer work. • Other ______________________________
Is the monitor at least 18" away from the eyes?	☐ NO ⇨ ☐ YES ⇩	• Move monitor further away on desk surface. • Use a keyboard tray to move the keyboard further back. • Install a corner unit with more room for the monitor. • Other ______________________________
Does the monitor display have the following characteristics: • have good contrast, with crisp, clear text? • have a high enough brightness level? • have bright backgrounds that are free from flicker?	☐ NO ⇨ ☐ YES ⇩	• Adjust brightness and contrast controls to improve image and reduce flicker. • Display black characters on a white background for improved contrast. • Have a PC technician optimize resolution and refresh rate on the graphics card. • Repair or replace older monitors. • Other ______________________________

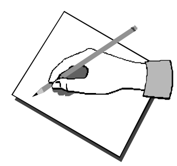
NOTE: If you have problems with glare on the monitor, see the Environment section of the Troubleshooting Guide.

Other Office Equipment

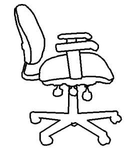



Questions		Recommended Solutions
Is the telephone typically used without having to cradle the handset between the ear and shoulder?	☐ NO ⇨ ☐ YES ⇩	• Use a speakerphone in private offices. • Use a headset in cubicles or open office areas. • Other ______________________________
Can 10-key calculators and other devices with keypads be used in a neutral posture?	☐ NO ⇨ ☐ YES ⇩ ☐ N/A ⇩	• Make room so that keypad devices can be pulled close. • Use a padded wrist rest for use during pauses in keypad entry. • Place devices on pull out "bread boards" to place them at the appropriate height. • Look for ways to consolidate keypad device functions onto the computer, such as using tape calculator software in place of the 10-key calculator. • Other ______________________________

Paper Documents



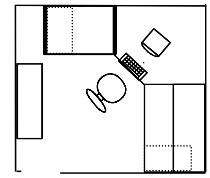
Questions		Recommended Solutions
Are documents that are referenced while typing at the computer placed on copyholders *immediately* to the side of or just below the monitor? *(Not just on the desk but more than 6 inches from the monitor.)*	☐ NO ⇨ ☐ YES ⇩ ☐ N/A ⇩	• Place documents on copy holders to the side of the monitor and at the same height, or between the monitor and the keyboard. • Make sure copyholders are large enough to handle the size of the documents in use. • Other ______________________________
Are carbon or carbonless copy forms that must be filled out by hand avoided?	☐ NO ⇨ ☐ YES ⇩ ☐ N/A ⇩	• Fill out multiple copy forms on the typewriter. • Create electronic forms that can be filled out on the computer and print multiple copies. • Other ______________________________



Chairs

Questions		Recommended Solutions
Is the chair appropriately sized for the user (e.g., seat width/length/height, back width/height)?	☐ NO ⇨ ☐ YES ⇩	• Place a rolled up towel or attach a removable back support cushion to existing back support to decrease length of seat pan. • Investigate options for exchanging/obtaining chair for better fit.
Does the backrest provide adequate support in the low back?	☐ NO ⇨ ☐ YES ⇩	• Place a rolled up towel or attach a removable back support cushion to existing back support. • Remove or lower arm rests which may prevent sitting back fully due to contact with front of desk or keyboard tray. • Adjust the backrest so the small of the back is in contact with the most outward curved area of the back support. • Replace the seat pan if it's too long and doesn't allow for sitting back fully in chair. • Other ______________________
Typically, are feet comfortably touching the floor or footrest?	☐ NO ⇨ ☐ YES ⇩	• Adjust chair seat height so feet are supported by the floor. • Use a footrest to support feet. • Other ______________________
Does the employee typically sit against their backrest while using their keyboard or mouse?	☐ NO ⇨ ☐ YES ⇩	• Reposition keyboard closer to chair. • Shift chair closer to worksurface, removing potential obstacles such as armrests that contact worksurface or items stored beneath the worksurface. • Concentrate on maintaining contact between your upper back and the chair backrest. • Other ______________________
Is the seat pan short enough so that the front edge of the seat does not impinge on the back of the knees or causes the employee to slump?	☐ NO ⇨ ☐ YES ⇩	• Adjust the back rest/lumbar support forward to shorten seat. • Place a rolled up towel or attach a removable back support cushion to existing back support. • Replace the seat pan if it's too long and doesn't allow for sitting back fully in chair. • Other ______________________
Do armrests support the forearms without resulting in hunched shoulders (armrests too high) or leaning to one side (armrests too low)?	☐ NO ⇨ ☐ YES ⇩	If armrests are too low: • Add padding to bring them up to a comfortable level. • Replace with height adjustable armrests. If armrests are too high: • Only use the armrests during short pauses from typing. • Replace with height adjustable armrests. • Other ______________________
Are the armrests designed so that they don't bump into worksurfaces or otherwise interfere with movement or sitting close enough to the keyboard?	☐ NO ⇨ ☐ YES ⇩	• Remove armrests that interfere with good work postures. • Lower adjustable armrests so that they fit under writing work surfaces. • Replace loop arms with "T" shaped arms that allow the chair to be pulled closer to keyboard worksurfaces. • Other ______________________
Are armrests padded or contoured to avoid hard or square edges?	☐ NO ⇨ ☐ YES ⇩	• Add padding to armrests that are low enough to allow this. • Remove armrests where added padding would cause hunched shoulders. • Replace armrests with padded ones at the appropriate height. • Other ______________________

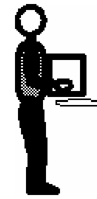
Work Space



Questions		Recommended Solutions
Are hands/wrists free from contact with a sharp desktop edge?	☐ NO ⇨ ☐ YES ⇩	• Move keyboard/input device to the edge of desktop to avoid resting hands/wrists on edge. • Use a wrist rest for support during pauses in typing. • Pad sharp edges on desktop with foam (e.g. - pipe insulation). • Install keyboard tray with wrist rest for support during pauses in typing. • Other ________________________________
Are desktop accessories (e.g., telephone, stapler, manuals) within easy reach and arranged according to frequency of use?	☐ NO ⇨ ☐ YES ⇩	• If right-handed arrange accessories (except telephone) to the right of computer. • Locate telephone on the left in order to answer with the left hand and take notes with the right. Just the opposite if left-handed. • Determine which accessories are used most frequently and locate them closest to you. • Other ________________________________
Is the space configured for proper placement (i.e., inline and within comfortable reach) of monitor, keyboard, and input device?	☐ NO ⇨ ☐ YES ⇩	▪ Install keyboard tray to allow proper placement of keyboard, monitor, and input device. Place CPU on floor in vertical stand to free up space on desktop. • Install free-floating monitor stand to bring monitor off the desktop. ▪ Other ________________________________
Is there adequate space for knees and legs underneath work surface (i.e., no boxes, trash receptacles, and cables to limit movement?	☐ NO ⇨ ☐ YES ⇩	• Remove materials underneath desk. • Raise desktop surface if taller individual has problems bumping into desktop edges, or lower chair. • Install keyboard tray to increase distance between monitor and desktop and provide more legroom. • Other ________________________________
If used often, is the reach to overhead storage spaces comfortable and convenient?	☐ NO ⇨ ☐ YES ⇩ ☐ N/A ⇩	• Place frequently used items on the desk surface rather than overhead. • Stand and use both hands to lift items from storage. • Lower adjustable height storage units as far as possible without interfering with monitor placement or other work. • Other ________________________________

Environmental Analysis

Questions		Recommended Solutions
If glare is a problem, is it minimized by placing computer monitors at right angles to bright light sources (windows, wall lamps, etc.)?	☐ NO ⇨ ☐ YES ⇩ ☐ N/A ⇩	• Turn monitor at right angle to window or bright light source. • Cover window with vertical blinds or shades. • Use anti-glare screen or monitor hood to reduce reflected images. • Other ______________________________
If glare is a problem, are monitors placed between rows of overhead light fixtures to avoid reflections?	☐ NO ⇨ ☐ YES ⇩ ☐ N/A ⇩	• Turn monitors at right angles to the length of the overhead light fixtures. • Install parabolic louvers (egg crates) in overhead light to direct light. • Use anti-glare screen or monitor hood to reduce reflections. • Other ______________________________
Is the light level behind and to the sides of the monitor similar to the light level emitted from the screen?	☐ NO ⇨ ☐ YES ⇩	• Turn monitor at right angle to window or bright light source. • Cover window with blinds or shades. • Reduce the amount of overhead lighting and use low wattage task lighting. • Other ______________________________
Are cubicles arranged so that there is adequate light on the worksurfaces?	☐ NO ⇨ ☐ YES ⇩	• Use supplemental task lighting in cubicles. • Reorganize cubicles to provide an even distribution of light. • Group computer users that require similar lighting levels in one area. • Reorient work surfaces in cubicle to provide light on needed surfaces. • Add overhead lights to reduce shadows and/or install diffusers to more evenly distribute light (be aware that either of these can increase glare on monitors, however). • Other ______________________________
Is reflected glare from the environment minimized?	☐ NO ⇨ ☐ YES ⇩	• Use a screen with an antiglare “flat” coating. • Avoid placing paper and other white objects where they cause reflections on the monitor screen. • Wear dark clothing to avoid seeing your own reflection. • Install parabolic (egg crate) louvers on overhead lights to direct light downward. • Install filters on overhead lights. • Paint walls and select furniture and equipment with a matte finish to reduce reflections. • Switch to indirect lighting (lights that reflect off of walls and the ceiling) and supplement with task lighting. • Other ______________________________
Are noise levels low enough that workers can work undisturbed by others conversations or equipment (computers, radios, copiers, ventilation)?	☐ NO ⇨ ☐ YES ⇩	• Provide separate enclosed rooms for meetings, private conversations, or break areas. • Repair and maintain equipment to prevent noisy malfunctions • Move noisy machines (copiers, staplers, fax machines, etc.) to separate rooms or floor to ceiling enclosures. • Discourage radio and telephone conversation levels that can be heard outside of the individual's cubicle. Provide separate offices for people who require privacy or who perform noisy tasks. • Use acoustical ceiling tiles and wall panels, carpet floors, and install noise attenuating cubicle panels. • Use electronic noise masking systems in open areas (note: noise masking systems located directly over occupied spaces may be annoying to nearby employees). • Other ______________________________



Lifting And Carrying

Questions		Recommended Solutions
Does your job involve frequent or heavy lifting?	☐ NO ⇨ ☐ YES ⇩	• The survey is complete. Thank you!
Are frequently lifted items kept between knee and shoulder height (not on the floor or overhead)?	☐ NO ⇨ ☐ YES ⇩	• Rearrange shelves to maximize storage at a convenient height. • Provide additional open work surfaces at waist height for temporary storage of items. • Other ______________________________
Can items be brought close to the body before being lifted (not bulky or awkward)?	☐ NO ⇨ ☐ YES ⇩	• Slide objects close to you before lifting. • Remove obstacles over which you would have to lift. • Use smaller containers that can be brought closer to your body. • Other ______________________________
Is lifting from the floor avoided as much as possible?	☐ NO ⇨ ☐ YES ⇩	• Store frequently used items on shelves. • Use a hand truck to move objects that are stored at floor level. • Unload containers rather than lifting while full. • Other ______________________________
Are the weights of loads to be lifted minimized into small units?	☐ NO ⇨ ☐ YES ⇩	• Break down large loads into smaller parts before moving. • Use smaller containers for storage. • Other ______________________________
Are items stored close to where they will be used to reduce carrying distances?	☐ NO ⇨ ☐ YES ⇩	• Create storage space to keep supplies near equipment (e.g. - printer stands with shelves for reams of paper). • Use carts and hand trucks to move supplies when storage cannot be created. • Other ______________________________
Are mechanical assistance devices (carts, hand trucks, chairs) available and used to help eliminate lifting and carrying by hand?	☐ NO ⇨ ☐ YES ⇩	• Slide items from shelves to the top of a cart at the same level to avoid lifting. • Have a number of carts available to use in place of carrying by hand. • Use a hand truck to move objects that are stored at floor level. • Use rollers for loading and unloading packages in the mailroom. • Other ______________________________
Are co-workers available and agreeable to help with heavy, awkward, or repetitive lifting tasks?	☐ NO ⇨ ☐ YES ⇩	• Encourage teaming up when lifting large containers that cannot be broken down. • Have several employees lift a few boxes each rather than a single employee lifting repetitively. • Other ______________________________
Are employees trained in proper lifting procedures?	☐ NO ⇨ ☐ YES ⇩	Train employees to: • Lift with the load close. • Minimize twisting by moving their feet. • Push rather than pull loads. • Use mechanical aids properly. • Ask for help if something is too heavy.
Are jobs designed so that lifting tasks are mixed with non-lifting tasks?	☐ NO ⇨ ☐ YES ⇩	• Assign lifting tasks to a number of employees who are physically capable. • Redesign lifting jobs to include less physically demanding tasks (e.g. - some desk work). • Use mechanical assistance to reduce or eliminate lifting. • Other ______________________________

END OF WORKSHEET

***Appendix 4*. Ergonomics and Workstyle Session Validity Checklist Forms**

Workstyle Study Rating Scale

(1) <u>SUPPORTIVE ENCOURAGEMENT:</u> Was the facilitator supportive of the participants by acknowledging participants' gains during sessions OR by reassuring that participants that gains will be forthcoming?

1	2	3	4	5	6	7
not at all		some		considerably		extremely

(2) <u>CONVEY COMPETENCE:</u> Did the facilitator convey that she/he understood the participants' problems and was able to help them?

1	2	3	4	5	6	7
not at all		some		considerably		very much

(3) <u>FACILITATOR'S COMMUNICATION STYLE:</u> How interesting is the facilitator's style of communication? *(Consider (1) the vividness of her/his language; (2) the originality of her/his ideas; (3) the liveliness of her/his manner of speaking).*

1	2	3	4	5	6	7
dull, uninteresting		less interesting than average		more interesting than average		very interesting

(4) <u>INVOLVEMENT:</u> How involved was the facilitator?

1	2	3	4	5	6	7
very detached		somewhat detached		mainly involved		very involved

(5) <u>WARMTH:</u> Did the facilitator convey warmth?

1	2	3	4	5	6	7
not at all or very little		some		a lot		very much

(6) <u>RAPPORT:</u> How much rapport was there between facilitator and participants (i.e., how well did the facilitator and participants get along)?

1	2	3	4	5	6	7
total absence of rapport		some rapport		considerable rapport		excellent rapport

(7) EMPATHY: Was the facilitator empathic toward the participants (i.e., did she/he convey an intimate understanding of and sensitivity to the participants' experiences and feelings)?

1	2	3	4	5	6	7
not at all		some		considerably		extensively

(8) FORMALITY: *(Defined as: Strict adherence to the therapeutic role such that little of the facilitator's own personality emerges during the session).* Did the facilitator adopt a formal stance in her/his interactions with the participants?

1	2	3	4	5	6	7
not at all		some		considerably		extensively

(9) COLLABORATION: Did the facilitator actively attempt to engage the participants in working together to explore therapeutic issues?

1	2	3	4	5	6	7
facilitator made no attempt to involve the participants in working together		facilitator occasionally attempted to involve participants in working together		facilitator frequently attempted to involve participants in working together		throughout the session facilitator actively solicited the participants' involvement in in working together

(10) ENCOURAGE INDEPENDENCE: Did the facilitator encourage the participants' independence from the facilitator in dealing with their problems?

1	2	3	4	5	6	7
no encourage-ment of the participants' independence		some encour-agement of participants' independence		much encour-agement of participants' independence		extensive encouragement of participants' independence from the facilitator

(11) LEVEL OF VERBAL ACTIVITY: How much did the facilitator talk?

1	2	3	4	5	6	7
said little or nothing		some		quite a lot		talked extensively

(12) EXPLICIT GUIDANCE: How much did the facilitator direct or guide the session in an explicit way?

1	2	3	4	5	6	7
facilitator offered no guidance OR guidance was not explicit		some		considerably		extremely

(13) SPECIFIC EXAMPLES: Did the facilitator urge the participants to give concrete, specific examples of beliefs OR events?

1	2	3	4	5	6	7
not at all		some		considerably		extensively

(14) SETTING AND FOLLOWING AGENDA: Did the facilitator specify and follow an agenda for the session?

1	2	3	4	5	6	7
not at all		some		considerably		thoroughly

(15) SUMMARIZING: Did the facilitator summarize OR encourage the participants to summarize key issues discussed either in a previous session or in the current session?

1	2	3	4	5	6	7
not at all		some		considerably		extensively

(16) HOMEWORK REVIEWED: Did the facilitator review previously assigned homework with the participants?

1	2	3	4	5	6	7
did not OR none assigned		some attention		considerable attention		extensively reviewed homework AND integrated into the rest of the session

(17) PREVIEWING THE SUBSEQUENT SESSION: Did the facilitator provide a preview of the key issues to be discussed in the subsequent session?

1	2	3	4	5	6	7
not at all		some		considerably		extensively

(18) <u>HOMEWORK ASSIGNED:</u> Did the facilitator assign one or more specific assignments for the participants to execute between sessions?

1	2	3	4	5	6	7
did not		some attempt to develop homework		considerable attempt to develop homework		extensive attempt to develop homework

(19) <u>SKILLS TRAINING:</u> Did the facilitator attempt to teach the participants skills in the session?

1	2	3	4	5	6	7
not at all		some		considerably		extensively

(20) <u>GOALS OF GROUP MEETINGS:</u> Did the facilitator describe the goals of group meetings (e.g., educate about WRUED symptoms/causes, workstyle modification, relapse prevention)?

1	2	3	4	5	6	7
not at all		some		considerably		extensively

(21) <u>WHAT TO EXPECT IN GROUP:</u> Did the facilitator review what participants can expect in the group (e.g., the type of discussions in group, homework, changes they may make)?

1	2	3	4	5	6	7
not at all		some discussion		considerable discussion		extensive discussion

(22) <u>WORKSTYLE EDUCATION:</u> Did the facilitator discuss the physiological, cognitive, and behavioral components of Workstyle?

1	2	3	4	5	6	7
not at all		some discussion		considerable discussion		extensive discussion

(23) <u>VISCIOUS WRUED CYCLE:</u> Did the facilitator discuss how the physiological, cognitive, and behavioral symptoms of workstyle can interact with and influence each other like a snowball effect?

1	2	3	4	5	6	7
not at all		some discussion		considerable discussion		extensive discussion

(24) ROLE OF PSYCHOLOGICAL FACTORS: Did the facilitator present a plausible role for psychological factors in WRUED onset/maintenance and a rationale for intervening on the psychological level?

1	2	3	4	5	6	7
not at all		some discussion		considerable discussion		extensive discussion

(25) WORKING TOO HARD: Did the facilitator describe the relationship between excessively forceful or rapid movements and WRUE symptoms?

1	2	3	4	5	6	7
not at all		some discussion		considerable discussion		extensive discussion

(26) REST & BREAKS: Did the facilitator present a plausible explanation for how rest and breaks can allow the upper extremities to recuperate from work and reduce WRUE symptoms?

1	2	3	4	5	6	7
not at all		some discussion		considerable discussion		extensive discussion

(27) RELAXATION EXERCISES: Did the facilitator demonstrate relaxation exercises while encouraging participants to follow along/try the techniques?

1	2	3	4	5	6	7
not at all		some		considerably		extensively

(28) FEAR OF MAKING MISTAKES: Did the facilitator describe how fears of making mistakes can be related to thoughts/beliefs that may or may not be true and can lead to increased stress and WRUE symptoms?

1	2	3	4	5	6	7
not at all		some discussion		considerable discussion		extensive discussion

(29) PERFECTIONISM: Did the facilitator describe how perfectionism can be related to thoughts/beliefs that may or may not be true and can lead to increased stress and WRUE symptoms?

1	2	3	4	5	6	7
not at all		some discussion		considerable discussion		extensive discussion

(30) IDENTIFYING NEGATIVE THOUGHTS/SELF-TALK: Did the facilitator discuss how negative thoughts/beliefs can be identified using the ABC model?

1	2	3	4	5	6	7
not at all		some discussion		considerable discussion		extensive discussion

(31) EXAMINE AVAILABLE EVIDENCE: Did the facilitator help the participants to use currently available evidence or information (including the participants' prior experiences) to test the validity of the participants' beliefs?

1	2	3	4	5	6	7
not at all		some		considerably		extensively

(32) SEARCHING FOR ALTERNATIVE EXPLANATIONS: Did the facilitator help the participants to consider alternative explanations for workplace events besides the participants' initial explanations for those events?

1	2	3	4	5	6	7
not at all		some		considerably		extensively

(33) REALISTIC CONSEQUENCES: Did the facilitator work with participants to determine what the realistic consequences would be if the participants' beliefs proved to be true?

1	2	3	4	5	6	7
not at all		some		considerably		extensively

(34) PRACTICING "RATIONAL RESPONSES": Did the facilitator and participants practice possible rational responses to the participant's negative thoughts or beliefs?

1	2	3	4	5	6	7
not at all		some		considerably		extensively

(35) EFFECTIVE COMMUNICATION: Did the facilitator describe communication styles and the LADDER Technique from improving communication?

1	2	3	4	5	6	7
not at all		some discussion		considerable discussion		extensive discussion

(36) PRACTICING EFFECTIVE COMMUNICATION: Did the facilitator and participants practice effective communication techniques in role-playing situations?

1	2	3	4	5	6	7
not at all		some		considerably		extensively

(37) <u>PROBLEM-SOLVING ACTIVITIES:</u> Did the facilitator address problems that can interfere with workstyle changes and how to manage them?

1	2	3	4	5	6	7
not at all		some		considerably		extensively

(38) <u>COMPREHENSIVE REVIEW:</u> Did the facilitator present a comprehensive review of the all material covered over the entire course of the workstyle workshops?

1	2	3	4	5	6	7
not at all		some mention of material		considerable review of material		extensive review of material

(39) <u>RELAPSE PREVENTION:</u> Did the facilitator discuss strategies for relapse-prevention (i.e., prevention of future adverse workstyle)?

1	2	3	4	5	6	7
not at all		some discussion		considerable discussion		extensive discussion

(40) <u>LONG-TERM PLAN:</u> Did the facilitator encourage participants to develop a personalized long-term plan to maintain gains, prevent relapse, and make positive life changes?

1	2	3	4	5	6	7
not at all		some		considerably		extensively

(41) DISCUSSION OF WORKSTATION DESIGN: Did the evaluator point out ergonomic risk factors in the worker's current workstation design and describe how these "poor ergonomics" can affect WRUE symptoms?

1	2	3	4	5	6	7
not at all		some discussion		considerable discussion		extensive discussion

(42) MODIFICATION OF WORKSTATION: Did the evaluator make modifications to the ergonomic risk factors that s/he identified?

1	2	3	4	5	6	7
not at all		some		considerably		extensively

(43) DISCUSSION OF EXCESSIVE FORCE: Did the evaluator describe how forceful motions increase the risk for symptoms and the need to use less force in task motions?

1	2	3	4	5	6	7
not at all		some discussion		considerable discussion		extensive discussion

(44) DISCUSSION OF EXCESSIVE REACHES: Did the evaluator describe how excessive reaches increase the risk for symptoms and the need to reduce excessive reaches?

1	2	3	4	5	6	7
not at all		some discussion		considerable discussion		extensive discussion

(45) DISCUSSION OF POSTURE: Did the evaluator describe how poor postures increase the risk for symptoms and explain how to improve posture?

1	2	3	4	5	6	7
not at all		some discussion		considerable discussion		extensive discussion

(46) ENCOURAGEMENT OF REST BREAKS: Did the evaluator provide rationale for rest breaks and encourage the worker to increase the number of breaks s/he takes throughout the workday?

1	2	3	4	5	6	7
not at all		some		considerably		extensively

(47) PROVISION OF ERGONOMIC MATERIAL: Did the evaluator provide the worker with the “Arranging Your Workstation to Fit You” booklet?

YES NO

Appendix 5. Survey Reminder Email

Thank you for your participation in the Workstyle Intervention Study. Your continued participation is essential to the completion of this study and the identification of intervention programs for work-related upper extremity symptoms/disorders.

At this time, we would like to ask you to complete the online survey once more. The procedures for this process are the same as before. The survey is on the website: http://131.158.28.200/mps/index.tpx (*usuhs.mil website with firewall protection*). Instead of your name, you will be asked to provide your participant ID number. Your assigned number will be:

(1,2,3,4)(###) (First Initial)(Last Initial).

This number will be the way that you are identified in the database to protect your privacy. Please keep this email so that you can provide the correct ID number. The survey will take 15-25 minutes to complete. Once you complete the survey, our staff will mail you a $10 check to your mailing address.

Thank you again for your participation in this study. Please contact the researchers at workstyle_study@hotmail.com or at 301-295-9660 with any questions or concerns.

Appendix 6. Workstyle Treatment Topics

REDUCING WORKSTYLE RISKS AND MANAGING UPPER EXTREMITY PAIN

Meeting 1: Introduction to Group

Introductions of Facilitator/Members
Purpose of the Group
Group Rules & Group Contract
Understanding Stress and Workstyle
Rationale: Stress and the Stress Chain (Stress Curve)
Workstyle and the Workstyle Model
Work-Related Upper Extremity Disorders (WRUEDs)
Individual Profiles of Workstyle
Group Discussion: What does workstyle my workstyle profile mean to me?
Homework: Increasing awareness of Workstyle and job stress
Stress Diary including Workstyle Monitoring

Meeting 2: Managing Workstyle – Part I

Meeting 2/Homework Follow-Up
Working Too Hard – Force and speed
Healthy Work Habits (Self Care and Breaks)
Relaxation Exercises
Group Discussion: Why do I work so forcefully?
When I work too much, what do I miss?
Homework: Stress Diary & Workstyle Monitoring
Practice relaxation & exercises
When are my symptoms worse?

Meeting 3: Managing Workstyle - Part II

Meeting 3/Homework Follow-Up
Fear of Making Mistakes
Perfectionism
Group Discussion: Mistakes – What's the Worst that Can Happen?
Perfect vs. Excellent
Effective Communication
Group Discussion: Saying no or help – Why is it so hard? (Role-playing)
Group Discussion: Putting It All Together
Setting Up a Continued Practice Plan
Contract for continued practice

Workstyle Treatment Guidelines

The workstyle treatment will be based on the specific subscale areas that are identified as being problematic for each individual. Each individual will be given information regarding his/her personal risk factors according to the subscales of the workstyle measure. A subscale will be considered a risk factor for that individual if his/her score on that subscale is one standard deviation above the mean score generated by the initial survey validation sample. Each participant will be given educational materials regarding intervention strategies for each subscale and these strategies will be discussed in the workshops as well. A description of the subscales and their associated treatment plans follow:

1. **Working Through Pain**: (Risk Score: ≤25) This subscale captures a construct relating to the tendency to work despite the presence of pain and/or WRUED symptoms. Training will include education, problem-solving, and other practice exercises to limit movements that are done with excessive force, speed, or reaches beyond an ideal working space. Examples of modifications for the behaviors captured under this subscale will include taking rest breaks and monitoring one's posture.
2. **Social Reactivity**: (Risk Score: ≤28) This subscale relates to fear of making mistakes evaluation apprehension related to the workplace. Training will include addressing these fears and understanding the inevitability of making mistakes and the realistic consequences of these mistakes. The goal for improvement of this area is to reduce the self-generated stress regarding these workplace concerns using group feedback, support, and personal experiences.
3. **Limited Workplace Support**: (Risk Score: ≤22) This subscale relates to a perceived lack of coworker support/social support and lack of supervisor support. Training will include teaching reasonable assertive communication and help-seeking skills in the work place and practicing these skills with others.
4. **Deadlines/Pressure**: (Risk Score: ≤23) This subscale relates to time pressure. Training will include time management skills for more efficient work habits, as well as practicing assertive communications regarding setting limits and asking for help from others, especially supervisor.
5. **Self-Imposed Workpace/Workload**: (Risk Score: ≤27) This subscale relates to perfectionism and workaholism that results in self-generated workplace stress. Training will involve reducing the unrealistic expectations of perfection through education, group feedback, and group discussions of personal experiences.
6. **Breaks**: (Risk Score: ≥2) This subscale addresses health behavior relating to breaks and rest. Group members will be given education about breaks, "microbreaks," stretching, and the importance of rest. Problem-solving and idea-generation about times and ways to take breaks/get rest will be conducted in the workshop.
7. The last four subscales (**Mood, Autonomic Response, Numbness/Tingling, and Pain/Tension**) are indications of the symptoms associated with an adverse workstyle. Individuals will be taught to recognize their specific symptom reactions to periods of increased work demands and will be encouraged to use these symptoms as "red flags" for "working through pain" or other workstyle-related risk factors. Relaxation techniques will be taught to all participants to reduce physical symptoms and perceived stress.

Appendix 7. Sample Workstyle Profile and Response Log

WORKSTYLE PROFILE

Instructions: Please write in your score for each subscale. If a subscale is a risk factor for you, try to notice what causes the thoughts/physical feels/behaviors occur (Triggers). Think about what barriers keep you from changing these behaviors. Next, read the recommendations and try to figure out a way that YOU think you can/will be able to make a change.

Working Through Pain (Subscale 1): Your score is _________.

If your score is 25 or higher, this is an area that is relevant for you. A high score in this area suggests that you may work in a painful way or with pain symptoms in order to get your work done. This behavior may lead to more pain over time. Therefore, consider the following behavioral options:

- **Take Breaks –**This includes taking restroom breaks, coffee breaks, and lunch breaks
- **Take Microbreaks throughout the day –**Take a moment to breathe deeply from your stomach, stretch your arms, shoulders, neck, etc. Develop a plan to take microbreaks during work pauses/interruptions.
- **Watch your behavior** - Is there a certain movement/posture that causes pain? Can you work in another way?

Triggers:____
____

Barriers that prevent change:____
____

My plan to change (what I can/will REALLY be able to do): ____________________

____

____

Social Reactivity (Subscale 2): Your score is ___________.

If your score is 28 or higher, this is an area that is relevant for you. A high score in this area suggests that you may be concerned about how your supervisors and/or coworkers may perceive your work and/or that you don't want to make mistakes. These thoughts can be stressful and can increase your overall pressure. Therefore, consider the following:

- **Ask for feedback –** "Supervisor, how am I doing?"
- **Talk to coworkers –** "Hi, let's chat."
- **Learn from others –** "How did/do you handle that?"

Triggers:____
____

Barriers that prevent change:____
____

My plan to change (what I can/will REALLY be able to do): ____________________

____

Limited Workplace Support (Subscale 3): Your score is __________.

If your score is 22 or higher, this is an area that is relevant for you. A high score in this area suggests that you may feel that you don't have all the tools you need to do your job. This lack of support also increases stress. You may want to consider:

- **Asking for help** – "I need help to get all this done."
- **Ask for feedback –** "Supervisor, how am I doing?"
- **Talk to coworkers –** "Hi, let's chat."
- **Support your coworkers –** "I'm free, let me help you."

Triggers:____

____
Barriers that prevent change:____
____
My plan to change (what I can/will REALLY be able to do): ______________________

____

____

Deadlines/Pressure (Subscale 4): Your score is ______________.

If your score is 23 or higher, this is an area that is relevant for you. A high score in this area suggests that you may feel overwhelmed and a sense of urgency at times. This "rushed" feeling often results in stress and changes in how you do your job. When you feel rushed, stop the urgency by:

- **Taking a deep breath –** as you exhale, imagine stressors floating away.
- **Communicate –** "Tell me what you need done first/now?"
- **Prioritize –** "One at a time. First this one, then later that."
- **Don't be afraid to say no** – "Sorry, I'm swamped. Maybe next time."

Triggers:____
____
Barriers that prevent change:____
____
My plan to change (what I can/will REALLY be able to do): ______________________

____

____

Self-Imposed Workpace/Workload (Subscale 5): Your score is ___________.

If your score is 27 or higher, this is an area that is relevant for you. A high score in this area suggests that you may be concerned with doing your work to a high standard and may hold yourself to a higher standard than anyone else does. Perfect work takes a lot of time and is not always feasible. You may wish to consider the following alternatives:

- **Work for Excellence, not Perfection –** Quality speaks for itself. You don't have to go overboard on details.
- **Let go – Delegate**. Allow others to demonstrate their abilities and creativity.
- **Be nice to yourself –**Would you be as hard on others? If not, ask why you are so hard on yourself?

Triggers:____
____
Barriers that prevent change:____
____
My plan to change (what I can/will REALLY be able to do): ______________________

____

____

Breaks (Subscale 6): Your score is _____________.

If your score is 2 or less, this is an area that is relevant for you. A low score in this area suggests that you may not take enough breaks to allow your body to rest. Rest recuperates the body and prevents injury. Remember that you use your muscles for movement, and just as when exercising, your muscles need to rest. You can get your rest by:

- **Getting away from your workstation at lunch and on breaks –**Try to stand up and walk around. Say hello to coworkers and/or get a drink of water.
- **Schedule time** - Set some time for rest by scheduling "pop ups" on your computer or a chime for your watch.
- **Take microbreaks –** take a few seconds throughout your task to pause, breathe deeply, and stretch.

Triggers:____
____
Barriers that prevent change:____
____
My plan to change (what I can/will REALLY be able to do): ____________________

____

____

Symptoms

Note your symptoms and use them as cues to take care of your mind and body. Try to take breaks, relax, and refocus whenever you notice any of your symptoms.

Mood (Subscale 7): Your score is __________.

If your score is higher than 5, you may experience a change in mood when using a risky workstyle. If this happens, remember to focus on your thoughts and behaviors related to work. Try to use relaxation techniques to reduce these changes.

Pain/Tension (Subscale 8): Your score is ___________.

If your score is higher than 3, you may experience a pain, stiffness, and tension when using a risky workstyle. If this happens, remember to focus on your thoughts and behaviors related to work. Try to use relaxation techniques to reduce these changes.

Autonomic (Subscale 9): Your score is ____________.

If your score is higher than 2, you may experience a change in body temperature or functioning when using a risky workstyle. If this happens, remember to focus on your thoughts and behaviors related to work. Try to use relaxation techniques to reduce these changes.

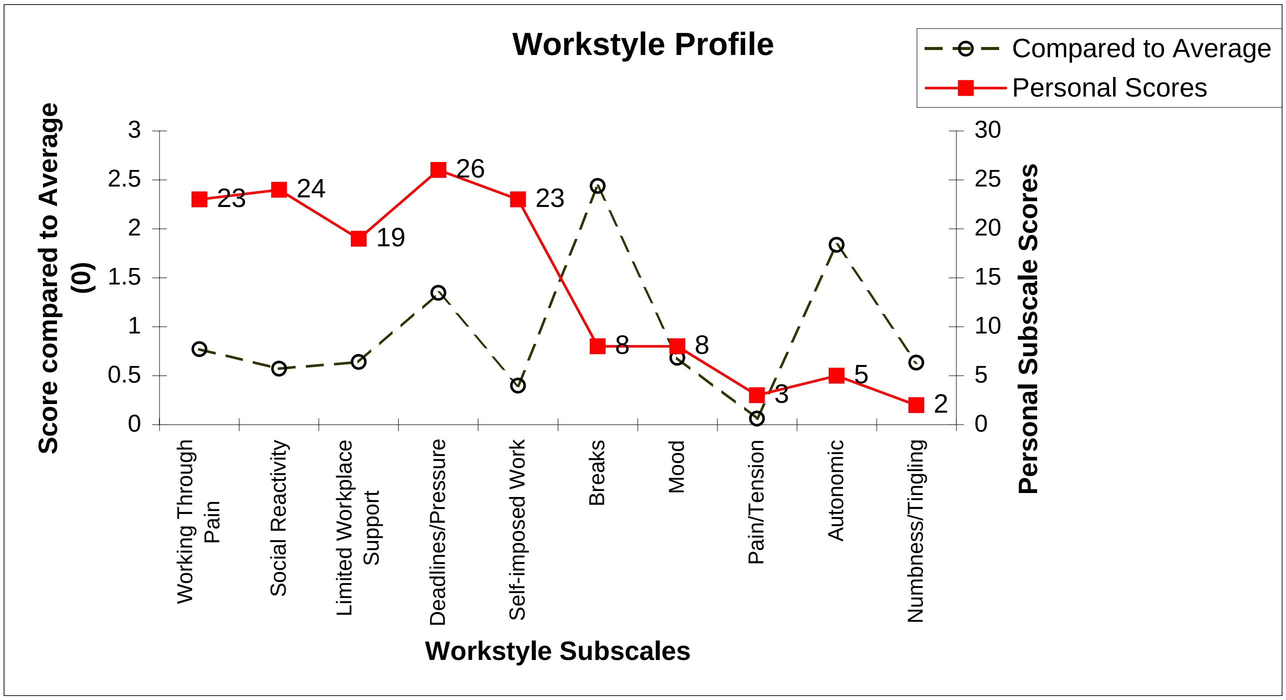
Numbness/Tingling (Subscale 10): Your score is ______________.

If your score is higher than 2, you may experience numbness/tingling in your body when using a risky workstyle. If this happens, remember to focus on your thoughts and behaviors related to work. Try to use relaxation techniques to reduce these changes.

Triggers:____
____
Barriers that prevent change:____
____
My plan to change (what I can/will REALLY be able to do): ____________________

____

____


Workstyle Profile
Compared to Average
Personal Scores
Score compared to Average (0)
Personal Subscale Scores
3
2.5
2
1.5
1
0.5
0
30
25
20
15
10
5
0
23
24
19
26
23
8
8
3
5
2
Working Through Pain
Social Reactivity
Limited Workplace Support
Deadlines/Pressure
Self-imposed Work
Breaks
Mood
Pain/Tension
Autonomic
Numbness/Tingling
Workstyle Subscales

Stress and Workstyle Response Log – (Workstyle Workshop #1 Homework)

Situation: My supervisor asked me to work on his slides for the management meeting and I was already working on something that was due at the end of the day.
Workstyle Behavior: I started breathing shallower, and I was hunched over the computer. I was angry with him and was pounding hard on my keys. I did not take a break for 3 hours.
Symptom Problem: My wrists and forearms were achy. My neck was stiff and painful.
Intensity: 3
Comments: I need to communicate and negotiate my time and deadlines with him. Maybe someone else could have helped. I also need to stop and relax for a minute and take breaks. Maybe pause between slides. Or get up for water.

Situation:

Workstyle Behavior

Symptom Problem:
Intensity:
Comments:

Situation:

Workstyle Behavior

Symptom Problem:
Intensity:
Comments:

Situation:

Workstyle Behavior

Symptom Problem:
Intensity:
Comments:

<u>Symptom problems:</u>	Aching	Burning	Cramping	<u>Intensity:</u>	1 = minimum
Stiffness	Numbness Pain	Swelling			3 = moderate
Weakness	Stiffness	Tingling	Fatigue		5 = intense

***Appendix 8*. Proposed Timeline of Events**

TASK	DATES
Project Initiation Activities - Gather data collection forms - Refine recruitment & screening procedures - Develop treatment manuals - Validity check forms	Jun 2003-Aug 2003
Recruitment & Screening - Develop and post flyers - Advertisement via newspapers and radio (if applicable) - Screening of potential participants	Aug 2003 – Nov 2003
Randomization & Treatment - Randomization of subjects - Ergonomic visits - Initiation of workstyle groups - **Baseline data collection**	Sep 2003 – Dec 2003
3 Month Follow-up Data Collection	Dec 2003 – Mar 2004
3 Month Follow-up Data Analysis	Mar 2004 – May 2004
3 Month Follow-up Reporting	May 2004-Jun 2004
Defense	Jul 2004

***Appendix 9*. Recruitment Advertising**

Recruitment Flyer

Computer Users

Do you work in an *office environment* full time?
Do you work on a computer at least 4 hrs/day?
<u>Do you experience pain, numbness, stiffness or tingling in your fingers, hands, wrists, forearms, elbows, shoulders and/or neck?</u>
If you answered **YES**,
you are invited to participate in a research study to examine different kinds of intervention programs to reduce and/or manage upper extremity symptoms/disorders.

Volunteers who are willing to participate in an intervention program are invited for this study. You may be asked to participate in a series of 20-minute ergonomic meetings and/or 90-minute workshops once a week for 4 weeks. Additionally, you will complete 4 surveys on-line. Questions are related to work and health. Some participants may receive access to ergonomic interventions and/or promising new programs for reducing upper extremity symptoms. You may not benefit directly from this study. However, participants will be paid for completing questionnaires.

To qualify and to participate please email
workstyle_study@hotmail.com

PIs: Rena Nicholas, M.S. & Michael Feuerstein, Ph.D.
Uniformed Services University of the Health Sciences

Appendix 10. Informed Consent Form

INFORMED CONSENT FORM
Workstyle Study

Research Study Title: Workstyle Intervention for the Management of Work-Related Upper Extremity Symptoms

Principle Investigators: Rena A. Nicholas, M.S.
Michael Feuerstein, Ph.D., MPH

Name of Volunteer: ____
(Please Print)

1. Introduction:

You are being asked to take part in a research study. Before you decide to be a part of this research study, you need to understand the risks and benefits so that you can make an informed decision. This is known as informed consent. This consent form provides information about the research study that has been explained to you. Once you understand the study and its requirements, you will be asked to sign this form if you want to take part in the study. Your participation is voluntary. This means that you are free to choose if you will take part in the study. You are also free to withdraw from the study at any time. If, during the course of the study you should have any questions about the study, your participation in it or about your rights as a research subject, you may contact:

a. Rena Nicholas, M.S., at 301-295-9660
Department of Medical & Clinical Psychology, USUHS, Bethesda, MD 20814
b. Michael Feuerstein, Ph.D., MPH, at 301-295-9677
Department of Medical & Clinical Psychology, and Department of Preventive Medicine and Biometrics, USUHS, Bethesda, MD 20814

2. Purpose of the Study:

You are invited to participate in a research study that will examine a new program designed to reduce and/or manage work-related upper extremity (fingers/hand/wrist/arm/elbow/shoulder/neck) musculoskeletal symptoms/disorders. Research has shown that many factors, such as the ergonomics of the workplace, the stress in the workplace, and some of the responses a worker makes when under high job demands puts them under increased risk for developing these symptoms. "Ergonomics" refers to the design of the workstation and/or the task demands that require postures and/or motions that deviate from neutral body aligment or create excessive loads on the body. "Workstyle" is a concept that describes how a person does their work under increased demands. Workstyle is made up of a person's behaviors, thoughts, and bodily responses to high work demands, such as fears of

Subject Initials______________- Date:____________
Witness Initials______________- Date:____________

making mistakes, working in awkward postures, and/or using rapid, forceful keystrokes. These thoughts and behaviors may lead to upper extremity symptoms, especially when there are also ergonomic risks and stress in the workplace. Currently, most treatments only address the ergonomics of the workplace. However, it is expected that changing a risky workstyle in addition to adjusting the ergonomics of the workplace may result in fewer symptoms and less distress for the worker. This study is designed to examine the effects of reducing risky workstyle factors and/or ergonomic exposures on upper extremity musculoskeletal pain in computer users.

3. Procedures Involved in the Study:

The purpose of this study is to compare four different interventions for work-related upper extremity symptoms. If you decide to participate, you will be randomly assigned to one of four groups:

a. **Ergonomics Intervention**: Participants receive ergonomic consultation at their workplace and modification to their existing workstation equipment. The participant is required to get these visits approved by the workplace/supervisor in advance of the meetings.
b. **Workstyle Intervention**: Participants attend four 90-minute workshops (once a week for four weeks) where they receive education and training about how they work, their workstyle risk factors, and how to modify their risk factors to reduce symptoms. These workshops involve small groups of 8-10 participants.
c. **Workstyle and Ergonomics Intervention**: Participants receive both the ergonomics intervention (with consultation and modifications) and the workstyle intervention (attend four workstyle workshops).
d. **Wait-List Control**: The purpose of the **wait-list control group** is to have something to compare the other three groups to. Control groups are commonly used in research. Participants receive no intervention but complete surveys describing their symptoms until the 12-month follow-up period. At that time, participants will receive the intervention that was shown to be the best for reducing symptoms in this study. However, participants in this group are free to access their usual modes of care for their symptoms (doctor visits, physical therapy, etc.) throughout the study.

Participants do not get to choose which group to participate in. Group assignments are based on a process called randomization, a method of making assignments by a chance procedure much like flipping a coin. We expect 160 people to participate in this study with 40 in each of the four groups. Participants in all four groups are free to contact their doctors, therapists, etc. regarding their symptoms, as they would normally do throughout the duration of the study. However, anyone who must take 3 or more consecutive days of sick leave because of symptoms in the upper extremity is asked to contact the researchers at 301-295-9660 to ensure that appropriate care for symptoms is received. If this happens, the researchers will ask you to contact your primary care manager.

Regardless of the intervention condition to which you are assigned, an ergonomics evaluator may visit your workplace up to two times for about 20 minutes each visit. During

Subject Initials______________- Date:____________
Witness Initials______________- Date:____________

these visits, the evaluator will examine your workstation. You are responsible for ensuring that these visits are approved in advance by your office staff and/or supervisor.

You will be asked to take an online survey (up to 40 minutes long) where you will report information about yourself, your workstyle, your workplace stress, the ergonomic design of your workplace, and your pain, symptoms, and functioning. You will be asked to take this survey a total of four times, once at the beginning of your participation, once after the interventions are completed (about 4 weeks), at three months following the second survey, and again at twelve months after the second survey. You will be paid $10 for each of the four surveys you complete, for a total of $40. You will be sent a reminder over email that will list the instructions on how to access the website and your privacy ID number, which you will use instead of your name on the survey to protect your privacy. Only the individuals directly involved in the study will have access to the master list that links the privacy ID number to your actual identifying information, and that master list will be kept in a locked, restricted access file.

4. Privacy:

All information that you provide as part of this study will be kept confidential and protected to the fullest extent of the law. Information that you provide and other records related to this study will be kept private, accessible only to those persons directly involved in conducting this study, members of the Institutional Review Board at the Uniformed Services University of the Health Sciences, and other Federal agencies who provide oversight for human use protection. No personal/identifying information collected in this study will be released to your employer. All forms and databases will be kept in restricted access, locked cabinets or under password-protected computers at the Uniformed Services University of the Health Sciences in Bethesda, Maryland when not in use.

To enhance your privacy, your name and identifying information (i.e., address, phone number, email address, etc.) will not be collected on the online study survey. You will instead be assigned a privacy ID number, which will be used to link your data to your identifying information (which is kept on a separate form in a locked, restricted access cabinet) if any such need arises. Otherwise, data from questionnaires will be coded into a database using only the privacy ID number to identify your information and responses. After all data is collected and the database information is verified, the hard copy of your name and personal information will be destroyed. Any reports of the study will use only data in the database and will not identify your name or personal identification information. Results from this study will be published in scientific journals.

5. Possible Discomfort and Risks Involved:

To the best of our knowledge, the risks associated with this study are minor. The online survey will ask information about your feelings of stress, how you work, your functioning, and your health, especially in terms of your upper extremity symptoms. This information may increase your awareness of your stress and your personal workstyle, which have been shown to be associated with upper extremity symptoms. You may also be identified as having a

“moderate” or greater depression and/or anxiety score; or may be identified as having some risk of suicide. If you are identified as having a “moderate” or higher score for depression and anxiety, and/or show risk for suicidality, you will be asked to contact your primary care provider or a licensed clinical psychologist/psychological treatment center (if you do not have a primary care manager) who will take steps to protect your safety.

You may be asked to discuss your experiences at work or regarding your symptoms in front of other people, but you may decline to do so. Additionally, the group meetings involve a 90-minute time commitment once a week for four weeks at the Uniformed Services University, which may be inconvenient. The online survey will ask information about your feelings of stress, how you work, your functioning, and your health, especially in terms of your upper extremity symptoms. Additionally, you may be asked to have ergonomics experts visit your location, which may cause some disruption at work. Every effort will be made to reduce any disruptions to your workplace and to permit you to schedule meetings at a time that is most convenient to you. You have the right to decline to participate at any time and/or withdraw your participation at any time.

6. <u>Possible Benefits Involved:</u>

You may not directly benefit from this study. However, possible benefits to you from being in this study may include learning more about your workstyle and identifying techniques to help you reduce risky workstyle responses. You may also benefit from a free intervention involving ergonomic modification of your existing work station/equipment and information about how to maintain ergonomically improved workstations. The reduction of risky workstyle responses and ergonomic modification of your workstation may reduce upper extremity symptoms and functional limitation. You may also experience a decrease in overall stress due to the stress management portions of the workstyle groups. Additionally, you will be providing information that will be helpful in expanding scientific knowledge about managing and preventing work-related upper extremity symptoms and disorders. The results of this study will be useful for the development of occupational health strategies to reduce and eliminate work-related upper extremity musculoskeletal disorders.

7. <u>Alternate Procedures that may be Advantageous:</u>

You may obtain medical treatments and ergonomic assessments elsewhere and we can provide you with a community referral at any time.

8. <u>Compensation:</u>

There are no costs to you for participating in this study. All workstyle modification interventions, ergonomic modifications, and education are provided to you free of charge. Additionally, you will be compensated $40 for completing all four surveys of this study. Payments of $10 each will be made after completing each survey.

Subject Initials______________- Date:____________
Witness Initials______________- Date:____________

9. Recourse in the Event of Injury:

This study should not entail any physical or mental risk beyond those described above. We do not expect any complications to occur, but if, for any reason, you feel that continuing this study would constitute a hardship for you, we will immediately end your participation in the study.

In the unlikely event of a medical emergency while participating in this study, you will receive emergency treatment in the facility you are in or a nearby medical facility (hospital or clinic). Emergency treatment/care will be accessed according to the company's Emergency Management Program policy. This policy states: "Emergency Management Program procedures instruct employees to contact Plaza Security at ext. 6733 (312-822-6733) in the case of a medical emergency. When Security receives a medical emergency call, they call 911 immediately, secure an elevator, place staff in front of the Plaza to direct emergency personnel into the building and onto the secured elevator, and escort them to the location of the emergency. Medical emergencies are generally defined as: severe injury or illness, difficulty breathing or chest pains, or requiring an ambulance or paramedic services. If you have a medical need or injury that does not require emergency services, please report the injury or medical condition to your manager. A manager or co-worker should accompany employees to a doctor's office or hospital as necessary."

If you believe the government or one of the government's employees has injured you, a claim for damages (money) against the federal government may be filed under the Federal Torts Claims Act. If you would like to file a claim please contact the University's Office of General Counsel and request the filing forms.

If at any time you believe you have suffered an injury or illness as a result of participating in this research project, you should contact the Office of Research at the Uniformed Services University of the Health Sciences, Bethesda, Maryland 20814-4799 at (301) 295-3303. This office can review the matter with you, can provide information about your rights as a subject, and may be able to identify resources available to you. Information about judicial avenues of compensation is available from the University's General Counsel at (301) 295-3028.

10. Use of Research Results:

The results of this research will appear in medical and/or scientific journals. All data will be presented in group format and findings about any individual will not be revealed in these publications. The results of the research will be provided to you if you so desire, at the termination of this research project. Please contact Ms. Rena Nicholas at 301-295-9660 or Dr. Michael Feuerstein at 301-295-9677 for study results.

11. Number of Participants in this Study:

This study is a single-center study because only this university will be participating in the study. There will be up to 160 office workers who use computers taking part in this study.

Subject Initials______________- Date:____________
Witness Initials______________- Date:____________

12. <u>Special Circumstances:</u>

In the event of emergency, please contact Ms. Rena Nicholas at 301-295-9660 or Dr. Michael Feuerstein at 301-295-9677.

If you are required to miss work for 3 or more consecutive days because of your upper extremity symptoms, please contact the researchers immediately.

Your decision whether or not to participate will not affect your care and relations with the faculty, staff and administration at USUHS will not be changed in any way. You should let the investigator in charge of the study know if you decide to stop the study. If you decide not to participate or are excluded from the study, all records that are traceable to you will be destroyed.

If you have any questions at any time about the study you may contact the principal investigators, Rena Nicholas, at the Department of Medical and Clinical Psychology, Uniformed Services University, at (301) 295-9660, or Dr. Michael Feuerstein, at the Department of Medical and Clinical Psychology and Department of Preventive Medicine and Biometrics, Uniformed Services University, at (301) 295-9677. If you have questions about your rights as a research subject, you should call the Director, Human Research Protections Program, in The Office of Research at the Uniformed Services University of the Health Sciences (301) 295-3303. This person is your representative and has no connection to the investigators conducting this study.

<u>STATEMENT AND SIGNATURE OF VOLUNTEER</u>

I have read this consent form and I understand the procedures to be used in this study and the possible risks, inconveniences, and/or discomforts that may be involved. All of my questions have been answered. I freely and voluntarily choose to participate. I understand I may withdraw at any time. My signature also indicates that I have received a copy of this consent form for my information.

Signature of Volunteer: ________________________________

Printed Name of Volunteer: ________________________________

Date: ________________________________

STATEMENT AND SIGNATURE OF INVESTIGATOR

I certify that the research study has been explained to the above individual by me or my research staff, and that the individual understands the nature and purpose, the possible risks and benefits associated with taking part in this research study. Any questions that have been raised have been answered.

Signature of Witness: ________________________________

Subject Initials_______________- Date:_____________
Witness Initials_______________- Date:_____________

Signature of Investigator: ________________________________

Printed Name of Investigator: ____________________________Date:____________________

Appendix 11. Workstyle Study Survey

Workstyle Study Survey

(Posted online at a USUHS website http://131.158.28.200/mps/Workstyle_Study.tp4)

Thank you for participating in the Workstyle Study. This questionnaire is intended to gather information about your personal characteristics, work, and health, all of which may be related to your upper extremity symptoms. The information you provide will be used to refine a program to manage and/or reduce work-related upper extremity symptoms for computer users world wide. Therefore, it is important that you answer each question completely and as accurately as you can. Please provide the answer that is relevant to you for most of the time. To protect your privacy, no identifying personal information is collected and your answers will be matched only to your study ID number.

Part 1: Sociodemographic Data

1. Study ID# ______________________________

2. Age:__________________________

3. Gender (circle one): M F

4a. Ethnicity
Do you consider yourself to be Hispanic or Latino? (A person of Mexican, Puerto Rican, Cuban, South or Central American, or other Spanish culture, regardless of race)
[ ] Hispanic or Latino [ ] Not Hispanic or Latino

4b. Race.
What race do you consider yourself to be?
[ ] American Indian or Alaska Native. (having origins in the original peoples of North, Central, or South America, and who maintains tribal affiliations or community attachment)
[ ] Black or African American. (having origins in any of the black racial groups of Africa)
[ ] Native Hawaiiam or Other Pacific Islander. (having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands)
[ ] White. (having origins in any of the original peoples of Europe, the Middle East, or North Africa)
[ ] Multi-racial (consider self to have origins in two or more of the races listed above)
[ ] Check here if you do not wish to provide some or all of the above information.

5. Dominant Hand (circle one): Right Left Both

6. Education (circle highest attained): Some High School High School/GED
Some College AA/Bachelor's
Some Graduate School Graduate Degree

7. Marital Status (circle one): Single Single but Cohabiting
Married Divorced Separated
Widowed

8. Number of children living in your home: ____________________

9. In an average week, how many times do you engage in physical activity (exercise or work which lasts at least 20 minutes without stopping and which is hard enough to make you breathe heavier and your heart beat faster)?

☐ Less than 1 time /wk ☐ 1 or 2 times /wk ☐ At least 3 times /wk

10. How often do you regularly do strengthening exercises (e.g., with weights or by holding a muscle tight)?

☐ Never ☐ Less than 1 time /wk ☐ 1 or 2 times /wk ☐ At least 3 times /wk

11. How often do you do stretching exercises?

☐ Never ☐ Less than 1 time /wk ☐ 1 or 2 times /wk ☐ At least 3 times /wk

12. How would you describe your cigarette smoking habits?

☐ Never smoked ☐ Used to smoke ☐ Still smoke

13. How many drinks of an alcoholic beverage do you have in a typical week below?

_______ Cans/Bottles of Beer ________ Glasses of Wine

________ Wine Coolers _________ Mixed Drinks or Shots of Liquor

14. How many years have you worked at your current job? ________________

15. How many hours per week do you usually work at your job? _________________

16. Please check all of the following treatments that you have received in the last 3 months or since completing the last survey for any type of pain or other problem in your hands, wrists, arms, shoulders, or neck:

MEDICAL: ☐ Nonsteroidal anti-inflammatory drugs (i.e., iboprofen, naprosyn) ☐ Oral steroids ☐ Local steroid injections ☐ Antidepressants for pain/sleep ☐ Chiropractic treatment ☐ Survery ☐ Other (specify): ______________________________________

PHYSICAL THERAPY: ☐ Splinting ☐ Muscle re-education ☐ Traction ☐ Transcutaneous nerve stimulation ☐ Ultrasound ☐ Stretching exercises ☐ Physical conditioning/supervised exercise ☐ Other (specify): ___________________

PSYCHOLOGICAL: ☐ Stress management ☐ Pain management ☐ Psychotherapy ☐ Hypnotherapy ☐ Biofeedback ☐ Other (specify): _______________________

17. How effective do you think your intervention group will be for reducing your upper extremity symptoms?

Not at all	A little bit	Moderately	Quite a bit	Extremely
☐	☐	☐	☐	☐

Part 2 – Workstyle

Please complete the following survey by checking the boxes that describe your experience at work.

<u>Part 1:</u>

Rate the degree to which each of the following items describes you at WORK by selecting the appropriate option

	Almost Never	Rarely	Sometimes	Frequently	Almost Always
1. I continue to work with pain and discomfort so that the quality of my work won't suffer.	[ ]	[ ]	[ ]	[ ]	[ ]
2. I continue to work in a way that contributes to pain in order to get my work done.	[ ]	[ ]	[ ]	[ ]	[ ]
3. My hands and arms feel tired during the workday.	[ ]	[ ]	[ ]	[ ]	[ ]
4. I continue to work in a way that contributes to pain in an effort to ensure quality.	[ ]	[ ]	[ ]	[ ]	[ ]
5. I feel achy when I work at my workstation.	[ ]	[ ]	[ ]	[ ]	[ ]
6. I don't know what to do about pain so I just keep working.	[ ]	[ ]	[ ]	[ ]	[ ]
7. Since there is really nothing that I can do about my pain in my hands/arms/shoulders/neck, I just have to work through the pain.	[ ]	[ ]	[ ]	[ ]	[ ]
8. I can't be bothered with these symptoms in my hands/arms/shoulders/neck, I must get my work done.	[ ]	[ ]	[ ]	[ ]	[ ]
9. There really isn't much I can do to help myself in terms of eliminating or reducing my symptoms in my hands/arms/shoulders/neck.	[ ]	[ ]	[ ]	[ ]	[ ]
10. My fingers/wrists/hands/arms (any one or combination) make jerky, quick, sudden movements	[ ]	[ ]	[ ]	[ ]	[ ]
11. I take medications to manage pain, muscle tension, or other symptoms in my fingers, wrists, hands, or arms in order to keep working.	[ ]	[ ]	[ ]	[ ]	[ ]
12. If I have to talk to my supervisor about my symptoms, it will appear that I can not handle the work.	[ ]	[ ]	[ ]	[ ]	[ ]
13. I don't think I am any different from anyone else in my office; we all have pain somewhere in our hands/arms/shoulders/neck.	[ ]	[ ]	[ ]	[ ]	[ ]

Indicate how often you THINK the following thoughts at work.	Almost Never	Rarely	Sometimes	Frequently	Almost Always
14. I can’t take off from work because other people at work will think less of me.	[ ]	[ ]	[ ]	[ ]	[ ]
15. I am afraid to take time off because I don’t want to be seen as a slacker.	[ ]	[ ]	[ ]	[ ]	[ ]
16. I can’t take off from work because I’d be letting down or burdening my boss.	[ ]	[ ]	[ ]	[ ]	[ ]
17. I can’t take off from work because I’d be letting down or burdening my coworkers.	[ ]	[ ]	[ ]	[ ]	[ ]
18. I can’t take off from work because I’d be letting myself down.	[ ]	[ ]	[ ]	[ ]	[ ]
19. I can’t take off from work because it will negatively affect my evaluations, promotions, and/or job security.	[ ]	[ ]	[ ]	[ ]	[ ]
20. I am afraid of making mistakes.	[ ]	[ ]	[ ]	[ ]	[ ]
21. If I take time off to take care of my health or to exercise, my coworkers/boss with think less of me.	[ ]	[ ]	[ ]	[ ]	[ ]
22. I am my own worst critic.	[ ]	[ ]	[ ]	[ ]	[ ]
23. I can’t take off from work because I need to work as much as I can to keep the paychecks coming.	[ ]	[ ]	[ ]	[ ]	[ ]
24. I feel like I can’t say no to more work.	[ ]	[ ]	[ ]	[ ]	[ ]
25. I would rather work overtime than ask for a deadline to be extended.	[ ]	[ ]	[ ]	[ ]	[ ]

Indicate how often you THINK the following thoughts at work.

	Almost Never	Rarely	Sometimes	Frequently	Almost Always
26. I don't really know where I stand despite all the effort I put into my work.	[ ]	[ ]	[ ]	[ ]	[ ]
27. I never know what is exactly expected so I just keep going.	[ ]	[ ]	[ ]	[ ]	[ ]
28. I put a lot of effort into this job and I am not recognized for it.	[ ]	[ ]	[ ]	[ ]	[ ]
29. My boss/coworkers won’t let me forget the mistakes that I have made.	[ ]	[ ]	[ ]	[ ]	[ ]
30. The boss doesn’t let you forget it if you don’t get your work finished.	[ ]	[ ]	[ ]	[ ]	[ ]
31. If I bring up problem(s) to my supervisor, like a coworker not pulling his/her weight, it won't make any difference anyway, so I just go ahead and do the work myself.	[ ]	[ ]	[ ]	[ ]	[ ]
32. My boss regularly sets unrealistic deadlines.	[ ]	[ ]	[ ]	[ ]	[ ]
33. It is frustrating to work for those who don’t have the same sense of quality that I do.	[ ]	[ ]	[ ]	[ ]	[ ]
34. There is always some kind of equipment problem that makes it hard to do my job.	[ ]	[ ]	[ ]	[ ]	[ ]
35. Old equipment and/or software make it really difficult to get my job done.	[ ]	[ ]	[ ]	[ ]	[ ]

Indicate how often you THINK the following thoughts at work.

	Almost Never	Rarely	Sometimes	Frequently	Almost Always
36. I have too many deadlines and will never be able to get all my work done.	[ ]	[ ]	[ ]	[ ]	[ ]
37. I have so many competing deadlines, I don't know where to start.	[ ]	[ ]	[ ]	[ ]	[ ]
38. I just keep getting more projects and deadlines.	[ ]	[ ]	[ ]	[ ]	[ ]
39. Even if I organize my work so that I can meet deadlines, things change and then I have to work even harder to get my work done on time.	[ ]	[ ]	[ ]	[ ]	[ ]
40. My schedule at work is very uncontrollable.	[ ]	[ ]	[ ]	[ ]	[ ]
41. I feel pressured when I'm working at my workstation.	[ ]	[ ]	[ ]	[ ]	[ ]
42. I really don't have time to take a break because of everything that must get done.	[ ]	[ ]	[ ]	[ ]	[ ]
43. I feel like I can't take time to go to lunch.	[ ]	[ ]	[ ]	[ ]	[ ]
44. I am physically exhausted at the end of the day	[ ]	[ ]	[ ]	[ ]	[ ]
45. I work into the evening in order to complete a project.	[ ]	[ ]	[ ]	[ ]	[ ]
46. I push myself and have higher expectations than my supervisor and others that I have to deal with at work.	[ ]	[ ]	[ ]	[ ]	[ ]
47. I always try to do my best because that's what I owe to myself.	[ ]	[ ]	[ ]	[ ]	[ ]
48. I do better work than my coworkers.	[ ]	[ ]	[ ]	[ ]	[ ]

Indicate how often you THINK the following thoughts at work.

	Almost Never	Rarely	Sometimes	Frequently	Almost Always
49. I work hard all day so that I can go home with a clear conscience.	[ ]	[ ]	[ ]	[ ]	[ ]
50. I put a lot of pressure on myself.	[ ]	[ ]	[ ]	[ ]	[ ]
51. My coworkers don't pull their weight and I have to take up the slack.	[ ]	[ ]	[ ]	[ ]	[ ]
52. Others tell me I should slow down and not work so hard.	[ ]	[ ]	[ ]	[ ]	[ ]
53. I feel like I have to get my work done today, because if I don't, I'll have to face it tomorrow.	[ ]	[ ]	[ ]	[ ]	[ ]
54. I can't slow my work pace. It is just not possible.	[ ]	[ ]	[ ]	[ ]	[ ]
55. I have to get through this project. When it is over, I'll go back to my normal work mode.	[ ]	[ ]	[ ]	[ ]	[ ]

Rate the degree to which each of the following items describes you at WORK by selecting the appropriate option

56. I take time to pause or stretch during a typical day at work.	[ ]	[ ]	[ ]	[ ]	[ ]
57. I take breaks when I am involved in a project at my workstation.	[ ]	[ ]	[ ]	[ ]	[ ]

Part 2:

<u>Check all the behaviors/emotions/symptoms</u> that you experience <u>only during periods of high work demands/work load.</u>

58. Anger [ ]

59. Out of Control [ ]

60. Have Trouble Concentrating/Focusing on Work [ ]

61. Depleted/Worn Out [ ]

62. Frustration [ ]

63. Grumpy [ ]

64. Overwhelmed [ ]

65. Short Fuse/Irritable [ ]

66. Dread [ ]

67. Don’t Want to Come to Work [ ]

68. Inertia (have trouble getting going) [ ]

69. Flustered [ ]

70. Loss of Energy [ ]

71. Fatigue – whole body [ ]

72. Neck pain [ ]

73. Neck tension [ ]

74. Neck stiffness [ ]

75. Shoulder tension [ ]

76. Back tension [ ]

77. Back pain [ ]

78. Gasping for breath [ ]

79. Cold feet [ ]

80. Clammy hands [ ]

81. Increased or decreased appetite [ ]

82. Cold hands [ ]

<u>Check all the behaviors/emotions/symptoms</u> that you experience <u>only during periods of high work demands/work load.</u>

83. Heartburn or upset stomach	[ ]
84. Nightmares	[ ]
85. Blurred vision	[ ]
86. Sleep problems after work	[ ]
87. Hard to turn head	[ ]
88. Feel weaker	[ ]
89. Hand/finger numbness	[ ]
90. Feel tingling down hands	[ ]
91. Forearm tightness	[ ]

Part 3. JRPD

. This section asks questions regarding the physical characteristics of your work/tasks.

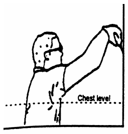


Figure A.

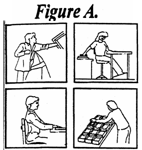


Figure B.

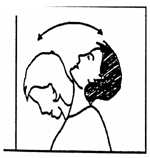


Figure C.

Figure D.

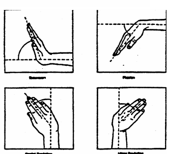


Figure E.

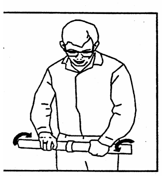


Figure F.

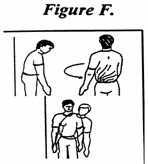


Figure H.

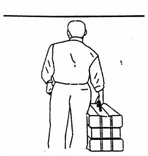


Figure I.

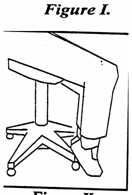


Figure K

Instructions: Indicate on average, how long you do this work on a daily (every day or weekly) basis.

Task	More than 4 hrs/day	2-4 hrs/day	Less than 2 hrs/day	Less than 5 hrs/week	Never
1. I work with my hands at or above chest level. (Figure A)	O	O	O	O	O
2. I reach/hold my arms in front of or behind my body (e.g., using keyboard, filing, handling parts, perform inspection tasks, pushing/ pulling carts, etc). (Figure B)	O	O	O	O	O
3. My neck is tipped forward or backward when I work. (Figure C)	O	O	O	O	O
4. I cradle a phone or other device between my neck and shoulder. (Figure D)	O	O	O	O	O
5. My wrists are bent (up, down, to the thumb, or little finger side) while I work. (Figure E)	O	O	O	O	O
6. I apply pressure or hold an item/material/tool (e.g., screwdriver, spray gun, mouse, etc. in my hand for longer than 10 seconds at a time).	O	O	O	O	O
7. My work requires me to use my hands in a way that is similar to wringing out clothes. (Figure F)	O	O	O	O	O
8. I perform a series of repetitive tasks/movements during the normal course of my work (e.g. using keyboard, tightening fasteners, cutting meat, etc).	O	O	O	O	O
9. The work surface (e.g., desk, bench, etc.) or tool(s) that I use presses into my palm(s), wrist(s), or against the sides of my fingers leaving red marks on or beneath the skin.	O	O	O	O	O
10. My hands and fingers are cold when I work.	O	O	O	O	O
11. I work at a fast pace to keep up with the machine production quota or performance incentive.	O	O	O	O	O
12. I squeeze or pinch work objects with a force similar to that which is required to open a lid on a new jar.	O	O	O	O	O
13. I lean forward continually when I work (e.g., when sitting, when standing, when pushing carts, etc.)	O	O	O	O	O
14. I repeatedly bend my back (e.g., forward, backward, to the side, or twist) in the course of my work.	O	O	O	O	O
15. When I lift, my body is twisted and/or I lift quickly. (Figure H)	O	O	O	O	O
16. I lift and/or carry items with one hand. (Figure I)	O	O	O	O	O
17. I lift or handle bulky items.	O	O	O	O	O
18. I lift materials that weigh more than 25 pounds.	O	O	O	O	O
19. I must constantly move or apply pressure with one or both feet (e.g. using foot pedals, driving, etc).	O	O	O	O	O
20. When I'm sitting, I cannot rest both feet flat on the floor. (Figure K)	O	O	O	O	O
21. I stand on hard surfaces.	O	O	O	O	O
22. I can see glare on my computer screen or work surface.	O	O	O	O	O
23. It is difficult to hear a person on the phone or to concentrate because of other activity, voices, or noise in/near my work area.	O	O	O	O	O
24. It is difficult to see what I am working with (monitor, paper, parts, etc).	O	O	O	O	O

Part 4. Stress

This section asks a series of questions regarding how you view your work. Please answer each question using the appropriate instructions for each area.

I. Using the scale below, please answer the following questions about your work situation. Please write in the number corresponding to the answer that best describes your agreement with the statement.

Disagree Strongly	Moderately Disagree	Neither Agree nor Disagree	Moderately Agree	Strongly Agree
1	2	3	4	5

________1. In my group, people cannot afford to relax.

________2. In our group, there is constant pressure to keep working.

________3. In my group there is a sense of urgency about everything.

II. The next series of questions asks how often certain things happen at your job. Using the scale below, please write in the number corresponding to the answer that best describes how often the statement applies to your job.

_______1. How often does your job require you to work **very fast**?

_______2. How often does your job require you to work **very hard**?

_______3. How often does your job leave you with **little time** to get things done?

_______4. How often is there a **great deal** to get done?

_______5. How often is there a **marked increase** in your workload?

_______6. How often is there a marked increase in the **amount of concentration** required for your job?

_______7. How often is there a marked increase in how **fast you have to think**?

_______8. How often are you **physically** exhausted at the end of the work day?

_______9. How often are you **mentally** exhausted at the end of the work day?

Part 5. Symptoms

1. Using the scale below where 0=no pain and 10=severe pain, please rate the severity of any pain in your hands, arms, neck, or shoulders during the past week.

□	□	□	□	□	□	□	□	□	□	□
0	1	2	3	4	5	6	7	8	9	10
No pain										Severe pain

2. Do you have pain, aching, stiffness, burning, numbness, or tingling in your NECK?
   [ ] Yes [ ] No (Skip questions 2a-2c and go on to question 3)

   2a. How long does this NECK problem usually last?
   [ ] less than one hour
   [ ] 1 hour to 1 day
   [ ] 1 day to 1 week
   [ ] more than 1 week to 2 weeks
   [ ] more than 2 weeks to 4 weeks
   [ ] more than 1 month to 3 months
   [ ] more than 3 months

   2b. How often do you have this NECK problem?
   [ ] Almost never (every 6 months)
   [ ] Rarely (every 2-3 months)
   [ ] Sometimes (1x per month)
   [ ] Frequently (1x per week)
   [ ] Almost always (daily)

   2c. On average, describe the intensity of the NECK problem in the past 3 months or since you last took the survey.
   [ ] No discomfort
   [ ] Mild
   [ ] Moderate
   [ ] Severe
   [ ] Unbearable

3. Do you have pain, aching, stiffness, burning, numbness, or tingling in your SHOULDER?
   [ ] Yes [ ] No (Skip questions 3a-3c and go on to question 4)

   3a. How long does this shoulder problem usually last?
   [ ] less than one hour
   [ ] 1 hour to 1 day
   [ ] 1 day to 1 week
   [ ] more than 1 week to 2 weeks

[ ] more than 2 weeks to 4 weeks
[ ] more than 1 month to 3 months
[ ] more than 3 months

3b. How often do you have this SHOULDER problem?
[ ] Almost never (every 6 months)
[ ] Rarely (every 2-3 months)
[ ] Sometimes (1x per month)
[ ] Frequently (1x per week)
[ ] Almost always (daily)

3c. On average, describe the intensity of the SHOULDER problem in the past 3 months or since you last took the survey.
[ ] No discomfort
[ ] Mild
[ ] Moderate
[ ] Severe
[ ] Unbearable

4. Do you have pain, aching, stiffness, burning, numbness, or tingling in your ELBOWS/ FOREARMS?
[ ] Yes [ ] No (Skip questions 4a-4c and go on to question 5)

4a. How long does this ELBOW/FOREARM problem usually last?
[ ] less than one hour
[ ] 1 hour to 1 day
[ ] 1 day to 1 week
[ ] more than 1 week to 2 weeks
[ ] more than 2 weeks to 4 weeks
[ ] more than 1 month to 3 months
[ ] more than 3 months

4b. How often do you have this ELBOW/FOREARM problem?
[ ] Almost never (every 6 months)
[ ] Rarely (every 2-3 months)
[ ] Sometimes (1x per month)
[ ] Frequently (1x per week)
[ ] Almost always (daily)

4c. On average, describe the intensity of the ELBOW/FOREARM problem in the past 3 months or since you last took the survey.
[ ] No discomfort
[ ] Mild
[ ] Moderate
[ ] Severe
[ ] Unbearable

5. Do you have pain, aching, stiffness, burning, numbness, or tingling in your WRISTS/ HANDS?

[ ] Yes [ ] No (Skip questions 5a-5c and go on to question 6)

5a. How long does this WRISTS/HANDS problem usually last?
[ ] less than one hour
[ ] 1 hour to 1 day
[ ] 1 day to 1 week
[ ] more than 1 week to 2 weeks
[ ] more than 2 weeks to 4 weeks
[ ] more than 1 month to 3 months
[ ] more than 3 months

5b. How often do you have this WRISTS/HANDS problem?
[ ] Almost never (every 6 months)
[ ] Rarely (every 2-3 months)
[ ] Sometimes (1x per month)
[ ] Frequently (1x per week)
[ ] Almost always (daily)

5c. On average, describe the intensity of the WRISTS/HANDS problem in the past 3 months or since you last took the survey.
[ ] No discomfort
[ ] Mild
[ ] Moderate
[ ] Severe
[ ] Unbearable

6. Please indicate which of the following activities or functions you have difficulty doing <u>because of your symptoms</u>. Place an "x" in the box that indicates how much difficulty you have with each activity.

	NO PROBLEM									MAJOR PROBLEM (Can't do it at all)
A. Sleeping………………….	1 □	2 □	3 □	4 □	5 □	6 □	7 □	8 □	9 □	10 □
B. Writing…………………..	1 □	2 □	3 □	4 □	5 □	6 □	7 □	8 □	9 □	10 □
C. Opening jars……………..	1 □	2 □	3 □	4 □	5 □	6 □	7 □	8 □	9 □	10 □
D. Picking up small objects with fingers…………………..	1 □	2 □	3 □	4 □	5 □	6 □	7 □	8 □	9 □	10 □
E. Driving a car more than 30 minutes………………….	1 □	2 □	3 □	4 □	5 □	6 □	7 □	8 □	9 □	10 □
F. Opening a door………….	1 □	2 □	3 □	4 □	5 □	6 □	7 □	8 □	9 □	10 □
G. Carrying milk jug from the refrigerator……………..	1 □	2 □	3 □	4 □	5 □	6 □	7 □	8 □	9 □	10 □
H. Washing dishes…………	1 □	2 □	3 □	4 □	5 □	6 □	7 □	8 □	9 □	10 □

7. In general, would you say your health is:

Excellent	Very good	Good	Fair	Poor
☐	☐	☐	☐	☐

8. The following questions are about activities you might do during a typical day. Does **your health now limit you** in these activities? If so, how much?

	Yes, limited a lot	**Yes, limited a little**	**No, not limited at all**
a) Moderate activities, such as moving a table pushing a vacuum cleaner, bowling, or playing golf	☐	☐	☐
b) Climbing several flights of stairs	☐	☐	☐

9. During the **past 4 weeks**, how much of the time have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

	All of the time	**Most of the time**	**Some of the time**	**A little of the time**	**None of the time**
a) **Accomplished less** than you would like	☐	☐	☐	☐	☐
b) Were limited in the **kind** of work or other activities	☐	☐	☐	☐	☐

10. During the **past 4 weeks**, how much of the time have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

	All of the time	**Most of the time**	**Some of the time**	**A little of the time**	**None of the time**
a) **Accomplished less** than you would like	☐	☐	☐	☐	☐
b) Did work or other activities **less carefully than usual**	☐	☐	☐	☐	☐

11. During the **past 4 weeks**, how much did pain interfere with your normal work (including both work outside the home and housework)?

Not at all	**A little bit**	**Moderately**	**Quite a bit**	**Extremely**
☐	☐	☐	☐	☐

12. These questions are about how you feel and how things have been with you during the **past 4 weeks**. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the **past 4 weeks**…

	All of the time	**Most of the time**	**Some of the time**	**A little of the time**	**None of the time**
a) have you felt calm and peaceful?	☐	☐	☐	☐	☐
b) did you have a lot of energy?	☐	☐	☐	☐	☐
c) have you felt downhearted and depressed?	☐	☐	☐	☐	☐

13. During the **past 4 weeks**, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?

All of the time	**Most of the time**	**Some of the time**	**A little of the time**	**None of the time**
☐	☐	☐	☐	☐

Part 6. Presenteeism

Below we would like you to describe your work experiences in the past month. These experiences may be affected by many environmental as well as personal factors and may change from time to time. For each of the following statements, please circle one of the following responses to show your agreement or disagreement with this statement in describing *your* work experiences in the past month.

1. Because of my upper extremity symptoms, the stresses of my job were much harder to handle.

Strongly disagree	**Somewhat disagree**	**Uncertain**	**Somewhat disagree**	**Strongly disagree**
☐	☐	☐	☐	☐

2. Despite having my upper extremity symptoms, I was able to finish hard tasks in my work.

Strongly disagree	**Somewhat disagree**	**Uncertain**	**Somewhat disagree**	**Strongly disagree**
☐	☐	☐	☐	☐

3. My upper extremity symptoms distracted me from taking pleasure in my work.

Strongly disagree	**Somewhat disagree**	**Uncertain**	**Somewhat disagree**	**Strongly disagree**
☐	☐	☐	☐	☐

4. I felt hopeless about finishing certain work tasks due to my upper extremity symptoms.

Strongly disagree	**Somewhat disagree**	**Uncertain**	**Somewhat disagree**	**Strongly disagree**
☐	☐	☐	☐	☐

5. At work I was able to focus on achieving my goals despite my upper extremity symptoms.

Strongly disagree	**Somewhat disagree**	**Uncertain**	**Somewhat disagree**	**Strongly disagree**
☐	☐	☐	☐	☐

6. Despite having my upper extremity symptoms, I felt energetic enough to complete all my work.

Strongly disagree	**Somewhat disagree**	**Uncertain**	**Somewhat disagree**	**Strongly disagree**
☐	☐	☐	☐	☐

7. How many days of work have you had to miss because of the symptoms in your neck, shoulders, arms, elbows, wrists, hands, or fingers?

___________________ days

***Appendix 12*. Workstyle Study Personnel**

Task	Name of Individual	Title of Individual
Workshop Facilitator Ergonomics Evaluator Screening/Randomizing/Scheduling	Rena Nicholas, M.S.	Primary Investigator
Audiotape Standardization Reviewer (Validity Check)	Heather Rogers	Graduate Student
Supervisor/Advisor	Michael Feuerstein, Ph.D., ABPP	Licensed Clinical Psychologist; Co-Investigator

Appendix 13. Ergonomic Education Material